FIPP/R289 suppl. 3

LIBRARY

OCT 23 1985

National Marine Fisheries Service
2570 Dole Street
Honolulu, Hawaii

Papers presented at the

EXPERT CONSULTATION ON THE REGULATION OF FISHING EFFORT (FISHING MORTALITY)

Rome, 17-26 January 1983

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

PAPERS PRESENTED

at the

EXPERT CONSULTATION ON THE REGULATION OF FISHING EFFORT (FISHING MORTALITY)

Rome, 17-26 January 1983

A Preparatory Meeting for the FAO World Conference on Fisheries Management and Development

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome 1985

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

M-40
ISBN 92-5-102257-7

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying or otherwise, without the prior permission of the copyright owner. Applications for such permission, with a statement of the purpose and extent of the reproduction, should be addressed to the Director, Publications Division, Food and Agriculture Organization of the United Nations, Via delle Terme di Caracalla, 00100 Rome, Italy.

© FAO 1985

PREPARATION OF THIS DOCUMENT

An Expert Consultation on the Regulation of Fishing Effort was convened by FAO in Rome, 17-26 January 1983, as one of the preparatory meetings for the World Conference. The purpose of the Consultation was to review the experiences of countries with fisheries management techniques. The report of the Consultation, as approved by the participants at the conclusion of the meeting, was distributed in 1983. The papers presented at the Consultation have been prepared as supplements to the Report. The first supplement contains the abstracts of the papers in three languages: English, French and Spanish. Supplement 2 contains those papers that specifically relate to the theoretical aspects of fisheries management and its practice in a general manner. This document, Supplement 3, contains those papers that cover the management approaches adopted and experiences by individual countries. Supplements 2 and 3 are available in English only.

Abstract

The papers contained in this Supplement are concerned with approaches to regulating fishing effort encountered by individual countries and experiences in the management of specific fisheries. The first paper, by way of introduction to the Supplement, describes the scientific process in formulating management advice within an International Commission and the second paper describes the procedures followed by a regional organization in implementing these scientific recommendations. The remaining papers describe fisheries management practices in individual countries, listed alphabetically, followed by management experiences for shrimp, snapper, lobster, herring, groundfish, anchovy, surf clams, halibut and sardine fisheries.

Distribution:

Participants
FAO Fisheries Department
FAO Regional Officers
Directors of Fisheries
Selector SM
Selector Fisheries Management

For bibliographic purposes this document should be cited as follows:

FAO, 1985 Papers presented at the Expert Consultation on the regulation of fishing effort (fishing mortality). Rome, 17-26 January 1983. A preparatory meeting for the FAO World Conference on fisheries management and development. FAO Fish.Rep., (298) Suppl.3:215-470

CONTENTS

Author	Title	Pages
Hoydal, K.	ICES processing in formulating management advice	215-230
Holden, M.J.	The procedures followed and the problems met by the European Economic Community in implementing the scientific recommendations of the International Council for the Exploration of the Sea on total allowable catches	231-239
Derham, P.J.	The problems of quota management in the European community concept	241-250
Rettig, R.B.	Practices and problems with licence limitation in the USA and Canada	251-273
Chappell, W.D.	United States fishing effort restrictions and fishing vessel licensing under the 200 -mile limit	275-281
Schowengerdt Jr.,L.N.	Enforcement of foreign fishing quota allocations by the United States Coast Guard	283-290
Tillion, C.V.	Fisheries management in Alaska	291-297
Yamamoto, T.	Fishery regulations adopted for coastal and offshore fisheries in Japan	299-306
Asada, Y.	Licence limitation regulations: the Japanese system	307-318
Shahrom bin Abdul Majid	Controlling fishing effort: Malaysia's experience and problems	319-327
Bain, R.	Vessel licences, gear control and fishermen licensing in Australia: Australian experience of these and related management measures	329-342
Waugh, G.D.	Regulation of fishing effort (fishing mortality) New Zealand	343-354
Fisheries Management Division	Management of the (US) shrimp fishery of the Gulf of Mexico	355-363
Baisre, J.A. Perez, A. Obregon, M.H. Cruz, R.	Regulation of fishing effort in Cuban Shelf fisheries: The case studies of shrimp, lane snapper and spiny lobster fisheries	365-390
Bar Ilan, M.	Fisheries management of Lake Kinnereth	391-398
Ben-Tuvia, A.	Biological basis for the fishery regulation and management of the Bardawil Lagoon, Mediterranean coast of Sinai	399-408
Crouter, R.A.	Quotas by fishing gear for the herring fishery of the Bay of Fundy	409-414

Author	Title	Pages
Grice, F. Colosi, P.	Management of the Atlantic groundfish fishery under the US Magnuson Fishery Conservation and Management Act, 1977-1982	415-419
McInnis, R.	Anchovy management by quota	421-430
Nicholls, B.	Management of the Atlantic surf clam fishery under the Magnuson Act, 1977 to 1982	431-447
Skud, B.E.	The history and evaluation of closure regulations in the Pacific halibut fishery	449-456
Zuleta, A. Serra, J.R.	The management of Chilean pelagic fisheries with emphasis on the Spanish sardine (Sardinops sagax musica)	457-470

ICES PROCEDURES IN FORMULATING MANAGEMENT ADVICE

by

Kjartan Hoydal
Secretary to the Advisory Committee on
Fishery Management (ACFM) of the International
Council of the Exploration of the sea (ICES)
Copenhagen, Denmark.

INTRODUCTION

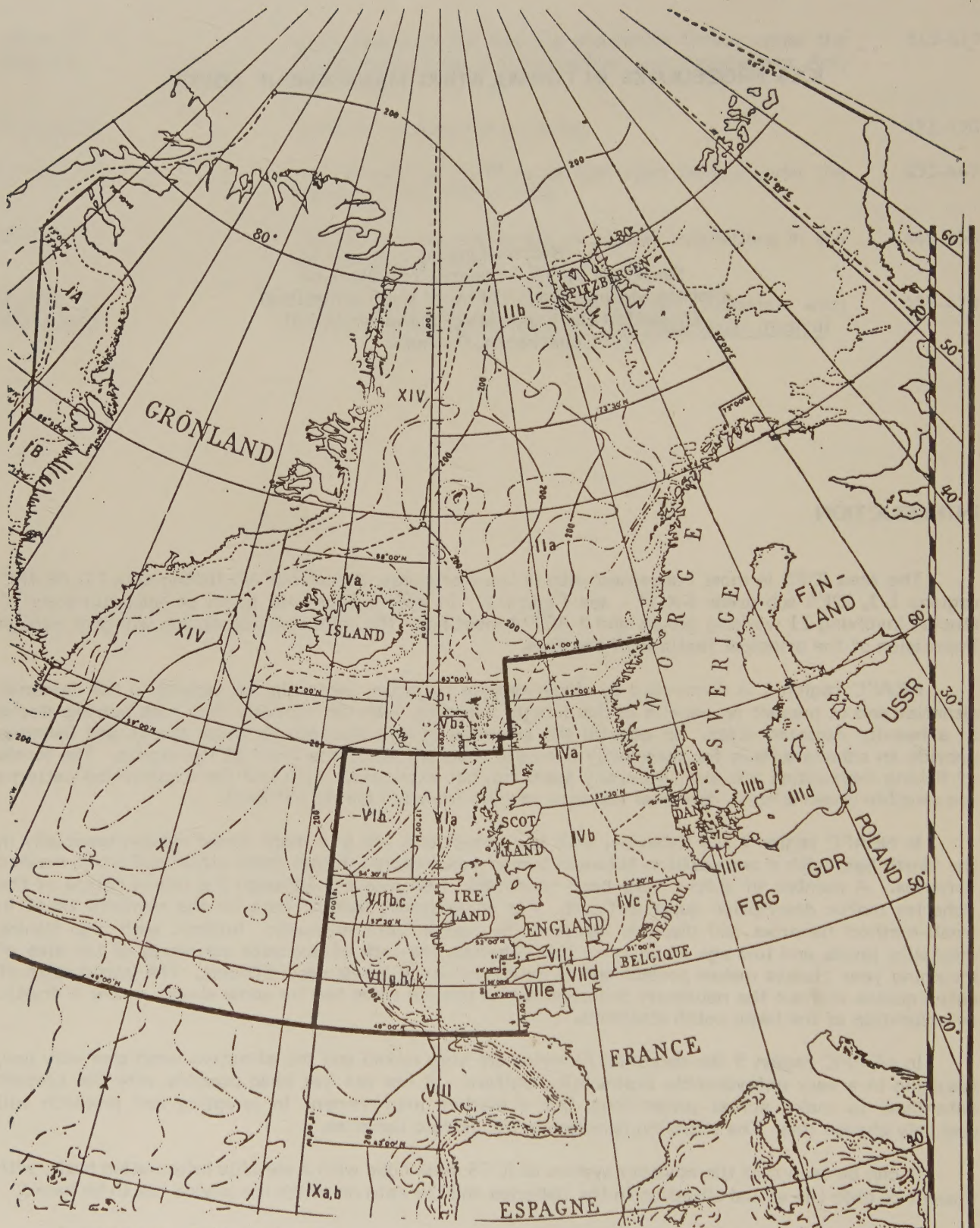
The area ICES is most concerned with is the North-east Atlantic (FAO fishing area 27, NEAFC regions 1-3, ICES sub-areas I-XIV) - see Figure 1. In 1982 advice was given on approximately 90 stocks, involving 21 working groups and 3 ACFM meetings. The following description will give a rough impression of the principal features of the area.

NEAFC region 1 is dominated by single-species fisheries, especially on gadoids in the demersal fisheries and at present on capelin in the pelagic fisheries, with the formerly very rich herring stocks in a heavily depleted state. In general the sampling of and research on these stocks and fisheries provide an adequate basis for reasonably accurate descriptions of the state of the stocks. The levels of fishing mortalities are also, generally speaking, not excessively high and the exploitation patterns are sensible (mesh sizes in demersal fisheries ranging from 120 mm to 155 mm).

In NEAFC region 2 the fisheries, with few exceptions, are of a more mixed nature, especially in the North Sea, with a competition between human consumption (larger mesh sizes) and small-meshed fisheries. A number of stocks have been reasonably well studied, although the mixed nature of the fisheries makes description quite difficult. For some stocks lack of data on the numbers taken in small-meshed fisheries and discards hampers the assessments seriously; further, with high fishing mortality levels and low age of entry to the fisheries, the lack of accurate estimates of the size of incoming year classes makes projections of catch and stock levels very difficult. The introduction of catch quotas without the necessary enforcement to control them has for some stocks meant a drastic deterioration of the basic catch statistics.

In NEAFC region 3 the demersal fisheries are very mixed and the effective mesh size very low, resulting in a very unfavourable exploitation pattern. It has not yet been possible with the present data base to make actual projections, but a marked improvement in sampling and research will probably change this. The situation is better in the pelagic fisheries.

It can be seen that the advisory system of ICES must cope with a variable information basis, with respect to both the actual situation in the fisheries and the data on which the advice has to be based.



Estimated mid-lines

200 200 mile limit

ICES division

NEAFC region

The designations employed do not imply the expression of an opinion whatsoever on the part of ICES concerning the legal status of any country or concerning the delimitation of its frontiers or boundaries.

Figure 1

The advice of ICES is submitted to the member States as well as to the North-East Atlantic Fisheries Commission (NEAFC) and the International Baltic Sea Fishery Commission (IBSFC), which have no scientific bodies of their own. The ICES area includes the EEZs of the following, starting from the north: Iceland, Faroe Islands, Norway, USSR, EEC (with 7 member States of ICES), Sweden, Finland, Poland, German Democratic Republic, Portugal and Spain.

THE PRODUCTION OF ADVICE BY WORKING GROUPS AND ACFM

Changes in international fisheries and the Law of the Sea have introduced changes in the formal advisory process within ICES over the years, but the basic philosophy has remained unchanged.

First, the basic description of the fisheries and the stocks exploited has been given by a working group which, ideally, has included scientists directly involved in the assessment work on a national level. Secondly, this description has been scrutinized by another group, up to 1978 the Liaison Committee and from 1978 onwards the ACFM, and converted to management advice.

The advantage of this system has been that the full utilization of specific local expertise has been guaranteed, while at the same time the later scrutiny of the Working Group Reports has secured a certain uniformity in quality and approach in all areas. The risk of contaminating the basic description with political considerations has also been reduced.

Up to 1974 the product from ICES was essentially a description of the state of the stock giving, if possible, an estimate of the fishing mortality level and, if any specific regulatory measures were discussed, these were mainly gear or area regulations.

From 1974 onwards catch regulations were to a higher and higher degree brought into focus, and at the time ACFM was set up the ICES product was, for almost every fish stock assessed, a recommended single figure TAC - every year. The basis of the recommendation was purely biological and is outlined in Cooperative Research Report No.62 (1977).

In 1980 ICES took steps to intensify the dialogue with managing bodies, and as a result, the product of the last two years has changed and is now an array of options "inside safe biological limits", which gives the managers the possibility of taking into account other factors than those strictly dependent on the biology of the stocks, on condition that none of the options given would endanger recruitment.

THE WORKING GROUPS AND THEIR METHODS

It should be noted that the changes in fisheries in the 1970s following the introduction of the EEZs had a very marked effect on the assessments or on the possibilities for producing accurate assessments. This was realized by the Liaison Committee already in 1972 (Coop.Res.Rep., No.31): "With the rapid changes in the fisheries and with the introduction of catch regulation, the comparability of the present abundance indices will become less and less precise. They are based on long established national patterns of fishing. Closed seasons, closed areas or quotas will disrupt these patterns, making it essential to obtain estimates of stock size independent of catch and effort data ..."

Where a working group in the early 1970s would have had a rather good measure of fishing intensity from long effort series or a measure of abundance from long catch per effort series, both describing fisheries which had been stable for many years, the working groups of the late 1970s found these important data series completely disrupted by the large-scale changes in fleet composition.

Further, the introduction of catch quota regulations demanded that ways be found to make very accurate predictions of catches in the years to which the catch quotas were to apply. This is a much more difficult task than indicating the general stock situation (e.g., the position of the present F on the yield per recruit curve).

The typical working group procedure to cope with this has been as follows:

The group establishes a data base with data for several years. At each meeting, this is updated with data for the last year in preliminary form, and the data for the year preceding it are brought into final form.

The data include yield by country, catch in numbers by age and country, and possibly catch per effort data and fishery-independent data (surveys, etc.). Table 1 shows the data available to the working groups meeting in 1981. It will be seen that the data base is rather variable.

The data on catch at age by country are aggregated to a combined estimate of total catch by age and year, and a VPA is run, which only differs from that of the previous year in that one year has been added.

Trial VPA runs are made. If data are at hand these are calibrated to effort data or survey data. Circumstantial evidence might also be used at this stage. At some point the group agrees on one of the trial runs as the final version.

Fishing mortality level for the last year and exploitation pattern are taken from the VPA, and from this and the catch, the stock as of 1 January in the year of the assessment is calculated.

To make a prediction for the following year, catches in the year of assessment have to be assumed and recruitment has to be estimated or assumed. Then projections of catch and stock biomass for the following years are calculated.

Schematically the procedures can be described as given below:

Fishing mortality estimated, total level and exploit-ation pattern	Stock as of 1 January calculated, catches assumed	Stock and yield projected
Last year with data	Year of assessment	Year of advice

PROBLEMS EXPERIENCED BY THE WORKING GROUPS

Table 1 shows which data are available for assessments of different stocks in the ICES area (Hoydal, 1981).

For the stocks where no analytical assessment has been possible, a precautionary TAC only can be indicated from catch figures over several years.

In a number of cases where an analytical assessment has been undertaken, the working group has only the catch at age data to go on, which means that the VPA cannot furnish a starting point for a projection. This makes the calculation of a TAC with any degree of certainty impossible. Experience has, however, shown that in some cases detailed knowledge of the fishery and anecdotal information of any kind can be very helpful, making it possible to pick one VPA to furnish the starting point for a projection. The best examples are the assessments done by the saithe working group (CM 1982/Assess:9).

Some groups will in addition to their catch at age data have detailed data on effort. The calibration of VPAs by effort data has been dealt with in recent ICES papers (e.g. CM 1981/G:5) and especially by the North Sea roundfish working group. There is no simple solution to this problem in a mixed fishery situation such as that in the North Sea, and experience has shown that the consistency of the effort series through the years used is especially critical.

Table 1 Data available to Fish Stock Assessment Working Groups' Meetings, March-May 1981

Region / Stock	Yield Data		Catch at Age Data		Discard Data		Fishery-independent Stock Estimate		Fishery independent Recruit Estimate		Effort Data		Comments
		Unrep. catches	Available	Used	Available	Used	Available	Used	Available	Used	Available	Used	
NE Arctic													
Saithe	x		x	x									Data on migration not used
Greenland Halibut	x		x	x							x	x	
Golden Redfish	x		x	x					x				Catches split by species on an area basis
Beaked Redfish	x		x	x					x		x	x	
East Greenland													
Prawn	x										x		Catch/effort data only covering part of the year
Cod	x	x	x	x			x	x	x				Migration data on age needed to improve assessment
East Greenland, Iceland, Faroes													
Greenland Halibut	x		x	x									Catch at age series short
Golden Redfish	x		x	x					x				Catch at age data based on age/length keys for only part of the fishery
Beaked Redfish	x		x	x					x				
Iceland													
Saithe	x		x	x									
Faroes													
Cod, Plateau	x		x	x					x		x	x	Effort series short because of large-scale changes in fisheries
Haddock	x		x	x					x		x	x	
Saithe	x		x	x							x	x	
Skagerrak Kattegat													
Herring	x	x	x	x	x	x	x	x	x	x			Separation of autumn and spring spawning components and interchange with adjacent areas cause problems in this assessment. No TAC calculated due to discrepancies between data sets
Sprat	x		x				x	x	x	x			No TAC estimate for 1982 yet possible as the year class 1981, which is the main component of the fishery is not yet born

Skagerrak/Kattegat continued...

Region / Stock	Yield Data		Catch at Age Data		Discard Data		Fishery-independent Stock Estimate		Fishery-independent Recruit Estimate		Effort Data		Comments
		Unrep. catches	Avail-able	Used	Avail-able	Used	Avail-able	Used	Avail-able	Used	Avail-able	Used	
Skagerrak Kattegat(ctd)													
Cod	x		x						x				Precautionary TAC
Haddock	x												Precautionary TAC
Whiting	x								x				Precautionary TAC
Plaice	x		x										Catch data not complete. TAC for Skagerrak on a precautionary basis
North Sea													
Herring	x	x					x	x	x	x			Fishery-independent stock estimates from larval survey used. Acoustic survey not used. No TAC for 1982
Sprat	x	x	x	x			x	x					Assessment for 1981 and 1982 only possible with shorter time lag between assessment and management. Acoustic surveys not used
Mackerel	x	x	x	x			x	x	x				Problems in stock delineation between the two components. This applies also to Western stock
Cod	x		x	x	x				x	x	x	x	
Haddock	x		x	x	x	x			x	x	x	x	
Whiting	x		x	x	x	x			x	x	x	x	
Saithe	x		x	x							x		Effort data for one country 1979-80, data on migration not used
West of Scotland													
Cod	x		x	x	x				x	x	x	x	
Haddock	x		x	x					x	x	x	x	
Whiting	x		x	x									
Saithe	x		x								x		Precautionary TAC, due to problems with data base

continued

Region / Stock	Yield Data		Catch at Age Data		Discard Data		Fishery-independent Stock Estimate		Fishery-independent Recruit Estimate		Effort Data		Comments
		Unrep. catches	Avail-able	Used	Avail-able	Used	Avail-able	Used	Avail-able	Used	Avail-able	Used	
West of Scotland(otd)													
Herring	x	x	x	x			x	x	x	x			
Clyde Herring	x		x	x									Interchange with adjacent areas not quantifiable. No analytical assessment
Sub-area VII (excl.Div.VIIa)													
Cod	x												No assessment
Haddock	x												
Whiting	x												
Irish Sea													
Herring	x	x	x	x			x						Composed by two different spawning units Manx and Mourne stocks
Cod	x		x	x							x	x	
Whiting	x		x	x					x		x	x	
Plaice	x		x	x					x	x	x	x	
Sole	x		x	x							x	x	
West of Ireland													
Herring (Div.VIIb,c)	x	x	x	x									No analytical assessment due to problems with data base
Herring (Div.VIIj)	x		x	x									No analytical assessment possible
Celtic Sea													
Plaice	x		x	x							x	x	Low percentage of catches covered by age samples
Sole	x		x	x							x	x	
Cod	x		x	x							x	x	Low percentage of catches covered by age samples
Herring	x	x	x	x			x						
Northern Hake	x	x	x		x				x		x	x	Data bases have been very incomplete but are improving. Precautionary TACs
Southern Hake	x	x	x		x				x				
Northern Blue Whiting	x		x	x			x	x			x	x	None of the data sets can at present support an absolute stock estimate. Precautionary TAC
Southern Blue Whiting	x		x										

Region / Stock	Yield Data		Catch at Age Data		Discard Data		Fishery-independent Stock Estimate		Fishery-independent Recruit Estimate		Effort Data		Comments
		Unrep. catches	Available	Used	Available	Used	Available	Used	Available	Used	Available	Used	
HERRING													
22-24	x	x	x	x					x	x			By-catch and discard data very incomplete
25,26,27	x		x	x			x	x					Migration data necessary
28, 29S	x		x	x									
Gulf of Riga	x		x	x									
29N, 30,31	x		x	x					x	x	x	x	Only Eastern stock assessed. Data series too short on Western side
32	x		x	x							x	x	
SPRAT													
22,24,25	x		x	x			x	x					
26, 28	x		x	x									
27,29-32	x		x	x									
COD													
22	x	x	x	x	x	x							Discard data limited. Migration data necessary
24	x	x	x	x	x				x	x			Low percentage of catch covered by age samples. Migration data necessary
25-32	x	x	x	x	x				x	x			
SALMON	x								x	x	x		

However, the major difficulties in making sufficiently accurate projections have occurred in two general situations, both hinging on the problem of predicting recruitment: when dealing with very short-lived species and with fisheries where the fishing intensity is very high. In both cases the fishery will be dependent on the strength of incoming year classes, and without methods to estimate this accurately it is impossible to predict yields corresponding to a given level of fishing mortality with any certainty. An improvement in the possibilities for making more detailed analyses of the abundant survey data from the North Sea is expected to reduce the scale of this problem.

For pelagic species, where catch per effort data are of no use, survey data are used extensively, and especially in the Barents Sea and the waters around Iceland the echo-integration surveys on herring and capelin have reached a high level of accuracy, which then allows quite accurate projections to be made.

There are in addition some major steps to be taken in the use of echo-integration for demersal species in the Barents Sea (CM 1983/Assess:2). These should give estimates of absolute stock size for calibration of the VPAs, in contrast to the indices which are output from most demersal surveys, and which demand a reasonable time series before the data can be of use.

Although in general requests addressed to ICES from managing bodies only ask for advice one year ahead, some working groups have tried to work out medium-term prospects. This would correspond to an attempt to define a medium or long-term level of fishery. The question of estimating recruitment in the years to come becomes then a major concern. It has not been possible to establish any clear stock-recruitment relationships which can be used, so either an average figure is calculated from the historic evidence of the VPA or the recruitment is treated as a stochastic variable, assuming that it can be described by a suitable distribution. This again allows calculation of the probabilities of reaching, e.g. a certain stock level or a certain yield (CM 1983/Assess:1).

THE ACFM FILTER

The working group reports are scrutinized by ACFM. This might result in major reassessments, if ACFM is not able to accept the findings of a working group or if it has reservations about methods or assumptions. In most cases ACFM will accept the assessments and translate them into actual advice. The form of the advice has changed. In the early days of ACFM, it would recommend a single figure. Now the presentation will be as seen in Figure 2. A summary of the history of the fishery and the stock, the yield curve with the present exploitation pattern, and a figure showing the consequences of different fishing intensities in the short term are given. In the body of the ACFM report options within safe biological limits are given and eventual additional conservation measures are indicated.

It should be noted that this two-tier system is quite time consuming. In 1983, for example, the first round of working group meetings starts in late February and ends in mid-April. With one to three group meetings at a time at ICES headquarters. The reports from these meetings have to be ready for the ACFM meeting in mid-May. A second round of meetings takes place in June, and the last group meets in September/October, reporting to a meeting in November. So altogether the advice for 1984 is an almost continuous process from February to November, and the managing bodies will not receive the final information from ACFM before late November. There can be a large gap between the actual time of the assessment made at a working group meeting and the time when the management advice is finally passed to the managers through ACFM.

STOCK FAROE PLATEAU COD SUB-DIVISION Vb_1

CATCH REC. TACs

1977		1978		1979		1980		1981		1982	
C	TAC	C	TAC	C	TAC	C	TAC	C	TAC	TAC	TAC
35	30	27	28	23	26	21	22	23	14	20*	

* Catch level preferred by ACFM

EFFECTIVE MANAGEMENT

135 mm mesh in trawl gears is strictly enforced. Total allowable catches for Faroese boat-groups are not enforced. Foreign vessels are regulated by quotas. A system of "boxes", and a trawl-ban inside 12 mile limit affects the exploitation.

QUALITY OF DATABASE

CATCH DATA	AGE/LENGTH DATA	EFFORT DATA	FISHERY INDEPENDENT
Adequate	Adequate	Data on total effort adequate, but usefulness at present restricted by the short series. Also, effort directed towards cod may be difficult to estimate.	0-group surveys have been conducted since 1974. Still of restricted use in assessment

DATA NECESSARY TO IMPROVE ASSESSMENTS

Fishery-independent survey data

THE 1982 ASSESSMENT

The spawning stock biomass has been declining from 120 000 tonnes in 1977 to 55 000 tonnes in 1981. However, in 1982-84 it is predicted to increase to the relatively high level of 80 000 tonnes.

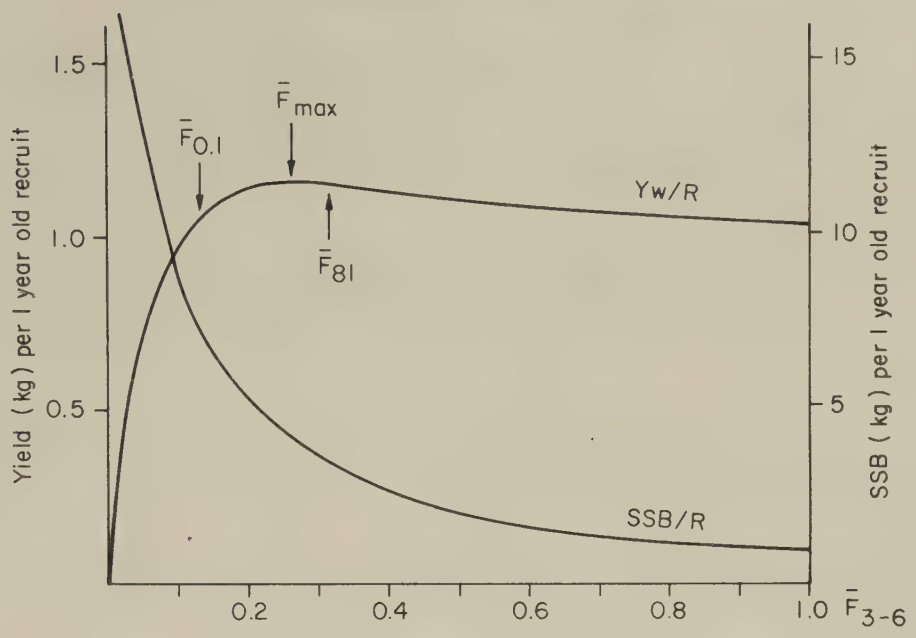
Current fishing mortality is about 20% higher than F_{max}. Predicted landings in 1982 are 25 500 tonnes. The catch for 1983 corresponding to F_{max} is 23 200 tonnes.

MANAGEMENT ADVICE

See para. 87

Figure 2 Example of Assessment/Summary, ACFM Report 1982

Faroe Plateau COD
Yield and spawning stock biomass per recruit



Faroe Plateau COD
Catch predictions for 1983 and spawning stock biomass at 1 January 1984

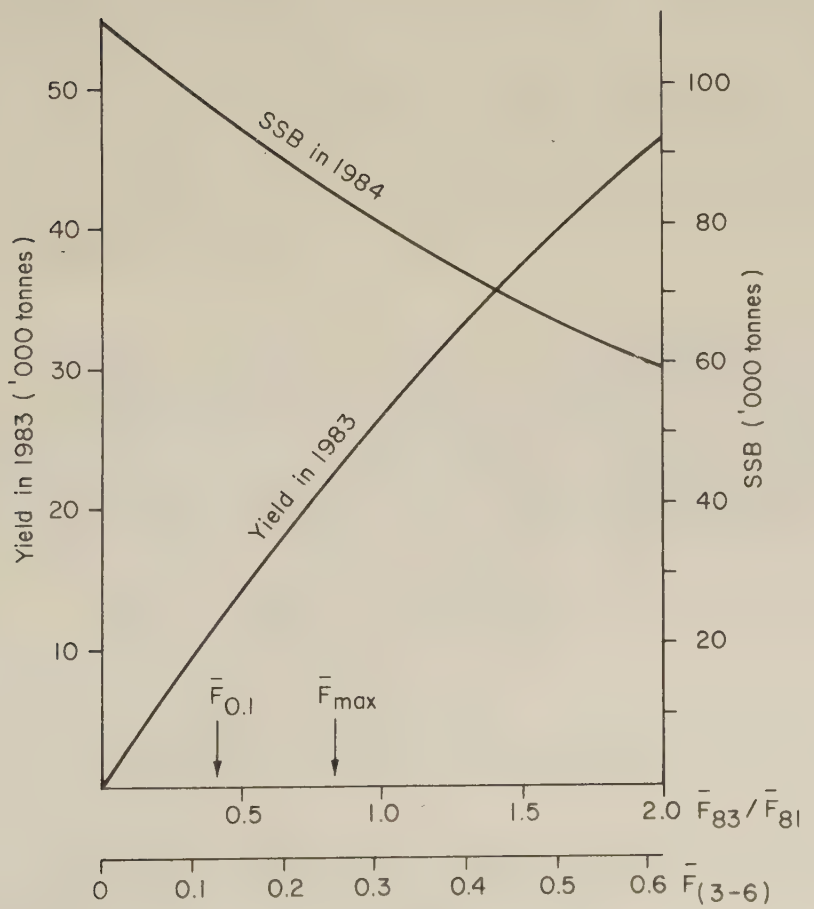


Figure 2

(continued)

Faroe Plateau COD.

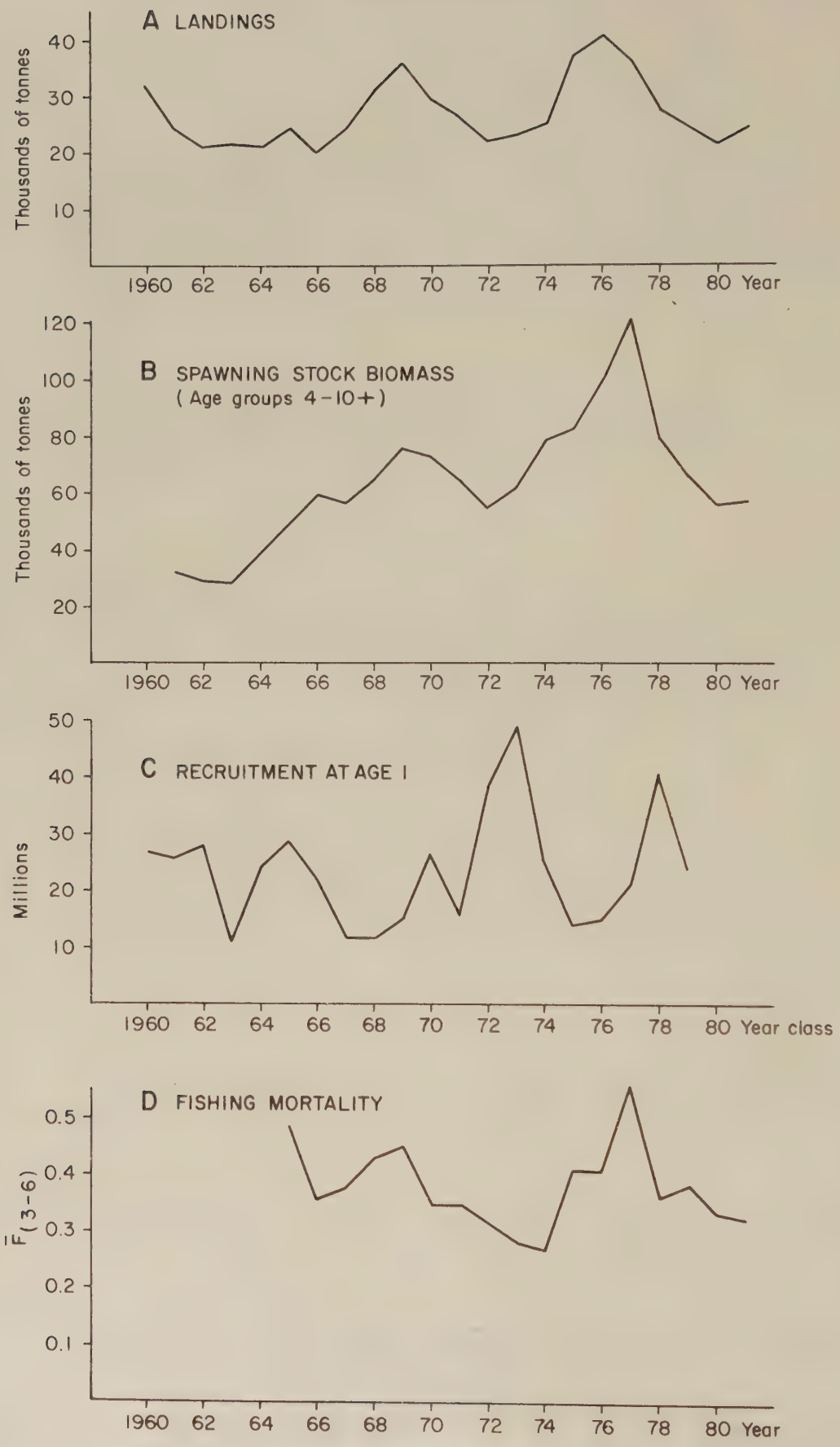


Figure 2

(continued)

DISCUSSION OF THE PRESENT PROCEDURES INSIDE ICES

In the continuous discussion of the basis of the advice given by ICES, three major reservations in principle have emerged, leaving aside all the cases where disagreement over an assessment is due to shaky data allowing several interpretations.

Of these three reservations two basically challenge the science and the third deals with the role of advice given by ICES in what has been termed "the fisheries continuum" of biology, fishery and socio-economics.

BASIC SCIENTIFIC PROBLEMS IN THE PRESENT ASSESSMENTS

The advice given at present is based on the assumption that the scientists are able to predict or at least project the consequences of certain levels of fishery on the stocks. This is discussed above.

But a more general criticism has been that the assessments do not take into account biological interaction (multi-species assessments) or technical interaction (multi-species fisheries).

The obvious example of the former is that pursuing, say, fishing operations at a very low mortality level in all fisheries in a certain region would change the predation pattern, so the benefits projected would not show up. The results of a large-scale experiment on stomach analysis in the North Sea will, it is hoped, throw light on the subject for this area. In the Baltic multi-species, assessment has been attempted but the data do not yet allow any firm conclusions to be made (CM 1982/Assess:15). The implications for the projections are apparent.

The obvious examples of the latter are from NEAFC regions 2 and 3, where "clean" fisheries are very rare if they exist at all, and therefore the total mortality on any one stock is caused by the combined effect of directed catches and by-catches of a number of fleets. This has an especially strong impact on the interpretation of the projections. For some stocks, assessments are at present made by type of fishery, thus predicting, for example, for North Sea whiting the yield taken in human consumption fisheries, fish discarded, and fish taken in the industrial small-meshed fisheries (CM 1982/Assess:8). There is a growing interest in proceeding further in this direction and attempting to make assessments on a "fleet basis" (see e.g., Sparre, 1980), but so far the results in actual management advice remain to be seen.

THE PROCESS FROM THE BIOLOGICAL DESCRIPTION TO VIABLE MANAGEMENT ADVICE

From 1974 on, the TAC became the magic word in fish stock management in the North-east Atlantic. As the starting point for any negotiation in the commissions or between coastal States, it was a figure deciding the fate of fisheries. With hindsight it can be seen that the TAC concept did not bring home the primary message, stating clearly the real benefits of management in the long term. By focussing on the short tem only the hardships of management were highlighted, i.e., the inevitable cuts which had to be suffered before a more satisfactory situation could be reached.

In general, the problem of regulating fishing effort by TACs has been described on several occasions, such as in the 1981 ACFM report (Coop.Res.Rep., No.114).

One of the serious problems was that the TAC was not tied to any explicit reference point. Quoting from the 1978 Report of ACFM (Coop.Res.Rep., No.85). "ACFM has, throughout this report, attempted to base its advice on gradually reducing the exploitation rate and improving the exploitation pattern in a phased programme, so as not to cause too great disruptions in current fishing activities."

So if, say, the assessment showed a fishing mortality level of 1.0, and the yield curve had an optimum at 0.2, ideally ACFM would for the first year calculate a TAC corresponding to a reduction in fishing mortality to 0.9, for the next year to 0.8, etc., until the appropriate level on the yield curve had been reached.

But it never turned out to be quite as simple as that. The following problems were encountered:

> No management action to cut down the fishing activity is agreed to, so next year the starting baseline is unchanged or has even gone up.
>
> A revision of an assessment gives a new estimate for the level of fishing mortality and a new exploitation pattern, so the baseline and the optimum aimed at change.
>
> Although the ACFM report clearly states the assumptions underlying the advice, thsee tend to disappear in the later events and only the single figure, the TAC, remains. This figure, depending on the case, may mean anything from an exact optimum on the yield curve to a fishing mortality level several times that.
>
> The single-figure advice does not give due consideration to other parts of the fisheries continuum, in effect giving the biologists the role of the managers and leaving to the managing bodies only the choice of accepting or rejecting.

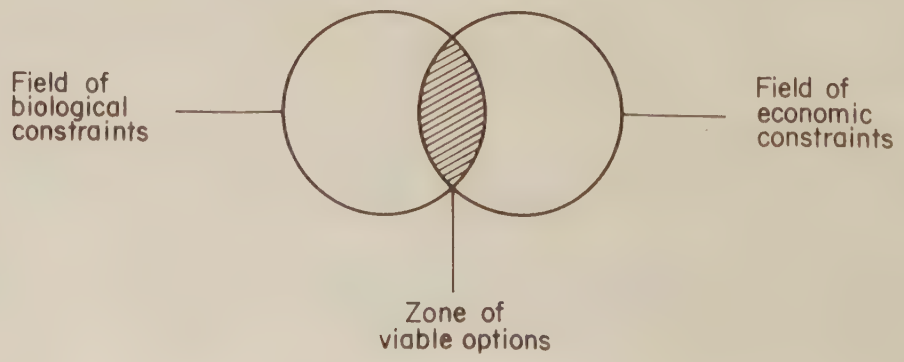
As one of the results of the so-called Dialogue Meeting at ICES, this whole approach has been changed, so the ACFM has gone from "normative to exploratory advice" (Hoydal, 1982).

This has obviously solved one of the problems and, according to management bodies, has increased the usefulness of the advice given to a considerable degree (Report from the 4th Dialogue Meeting, 1982).

But there still remains the question of how to get the biological constraints into the right place in the management of fisheries.

As pointed out by several authors, including Gulland (1979), the scope of management is essentially economic and certainly not biological. It is, generally speaking, a planning problem, as are so many others in modern society, and the decisions to be made which can guide the system towards a desired stage demand knowledge of, among other things, the biology of fish stocks, the fisheries themselves, the economy of fishing operations and related industries, and the influence of the benefits from the fisheries on other parts of society.

These problems are discussed by the present Chairman of ACFM in a recent paper (Griffith, 1982): "Biological advice can really only establish one set of constraints within which management ought to be applied. Even with the increased flexibility now built into ACFM advice, in order to provide managers with a wider range of options, it would appear that a course of action recommended on biological grounds has little chance of being accepted (and probably no chance of being implemented or enforced) unless it lies within that part of the biological 'field' which overlaps with the economic 'field'."



Based on the same kind of considerations ACFM, in its July 1982 report, has asked for a dialogue with economists on how to tailor the biological output to the needs of economic analysis.

Although this is a process which has just started on the ICES side, there has been a great deal of activity in this field on the national level, obviously an effect of the fact that, even though the fisheries may be international or multilateral, the socio-economic consequences must be evaluated on a national basis. Skimming through some of these attempts (e.g., Kristiansen, 1982) it is clear that one of the paramount demands is for better descriptions of "unit-fisheries" and "unit-fleets", and a gross figure for what might be taken from a unit stock is not in all cases a useful basis for decisions by management trying to achieve some economic optimization. Thus the increasing interest from the assessment angle in investigating technical interaction fits in very nicely with what is probably needed to "tailor the biological output to the needs of economic analysis".

THE TOTAL ALLOWABLE CATCH AND THE SURPLUS PROBLEM

From the above it is obvious that the concept of one figure for an allowable catch - as described in the International Convention adopted by the Third UNCLOS - which can be compared with actual catches in calculating a possible surplus, is not very meaningful.

When taking socio-economic factors into account, the concept seems to lose any sense. All kinds of allowable catches can be calculated, given economic and social constraints. Or, put differently, the TACs will depend on the management objectives.

This concept probably reflects the general lack of management objectives or targets for planning the fisheries.

DISCUSSION AND SUMMARY

Inasmuch as advice on management does not exist in a static world, ICES has also been undergoing changes, in response to changing demands.

Investigation into the period when ICES was providing a list of single-figure TACs shows that the following major problems were encountered:

(1) Sufficient accuracy in the calculation of TACs corresponding to certain levels of fishing mortality is difficult to obtain for some stocks and areas for a number of various reasons.

(2) The TAC is not based on any specific reference point, but can describe all levels of fishing mortality between the present level and a more optimal one.

(3) The TAC concentrates on the yield in one particular year and does not stress the need for long-term planning. For the long-term regulation of fishing-effort levels the TACs are very blunt instruments.

(4) The stock-by-stock figures are not very helpful in areas where fisheries are generally mixed.

(5) The single-figure TAC does not easily allow cosntraints other than biological ones to be taken into account in the management process.

The problems listed under (1) and (4) cannot be solved by changing from normative to exploratory advice, as has already been done by ICES. The solution of problem (5) requires:

(a) That the management objectives for the total fisheries continuum be stated.

(b) That the basic descriptions of this expanded planning system - allowing useful projections to be made - be provided.

The interactive process to implement this has started in the North-east Atlantic, but up to now only on a national level.

REFERENCES

ICES Mimeographed Meeting Reports

ICES, 1981 Report of the ad hoc Working Group on the use of effort data in assessments. ICES CM. 1981/G:5 (mimeo)

_____, 1982 Report of the North Sea Roundfish Working Group. Copenhagen, 23 March to 1 April. ICES CM. 1982/Assess:8 (mimeo)

ICES, 1982a Report of the Saithe (Coalfish) Working Group. Copenhagen, 20 to 27 April 1982. ICES CM. 1982/Assess:9 (mimeo)

_____, 1982b Report of the Working Group on multispecies assessment in the Baltic, ICES Headquarters, 4 to 13 May 1982. ICES CM. 1982/Assess:15 (mimeo)

_____, 1982c Report of the 4th Dialogue Meeting, Copenhagen, 8 October 1982 (draft) (mimeo)

_____, 1983 Report of the North Sea Flatfish Working Group. Copenhagen, 20 to 25 September 1982. ICES CM. 1983/Assess:1 (mimeo)

_____, 1983a Report of the Arctic Fisheries Working Group. Copenhagen, 21 to 28 September 1982. ICES CM. 1983/Assess:2 (mimeo)

ICES Cooperative Research Reports

ICES, 1972 Report of the Liaison Committee of ICES to NEAFC, 1972. Coop.Res.Rep.ICES, (31):27 p.

_____, 1977 Report of the ad hoc meeting on the Provision of Advice on the biological basis for fisheries management. Charlottenlund, 5-9 January 1976. Coop.Res.Rep.ICES, (62):16 p.

_____, 1979 Reports of the ICES Advisory Committee on fishery management, 1978. Coop.Res.Rep.ICES, (85):157 p.

_____, 1982 Reports of the ICES Advisory Committee on fishery management, 1981. Coop.Res.Rep.ICES, (114):280 p.

.....

Griffith, D. de G., 1982 Review of scientific advice on fisheries management, 1982. ICES CM. 1982/Assess:22 (mimeo)

Gulland, J.A., 1979 Long-term potential effects from management of the fish resources of the North Atlantic. ICES CM. 1979/G:58 (mimeo)

Hoydal, K., 1981 Review of the fish stock assessments made by ICES Working Groups in 1981. ICES CM. 1981/Gen:22 (mimeo)

_____, 1982 From normative to exploratory advice on fishery management and the general framework of advice. ICES CM. 1982/Assess:21 (mimeo)

Kristiansen, A., 1982 En Bioøkonomisk simuleringsmodell av linefisket ved faerøyene (A bio-economical model of the long-line fishery in the waters around the Faroes). Tromsø, 1982 (in Norwegian)

Sparre, P., 1980 A goal function of fisheries (Legion analysis). ICES CM. 1980/G:40

Tambs-Lyche, H., 1980 The role of the International Council for the Exploration of the Sea (ICES) in providing scientific advice. Translated from Annu.Fr.Droit.Int., 26

THE PROCEDURES FOLLOWED AND THE PROBLEMS MET BY THE EUROPEAN ECONOMIC COMMUNITY IN IMPLEMENTING THE SCIENTIFIC RECOMMENDATIONS OF THE INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA ON TOTAL ALLOWABLE CATCHES

by

M.J. Holden
Directorate General for Fisheries
Commission of the European Communities
Brussels

1. INTRODUCTION

Until 1977, management of fish stocks by means of total allowable catches (TACs) in the north-east Atlantic was carried out by the North-east Atlantic Fisheries Commission. At that time, management by an international organization was essential because the majority of fisheries limits did not extend beyond 12 miles. On 1 January 1977, all the member States of the European Economic Community (EEC), acting in common accord, extended their fisheries limits to 200 miles, or to the appropriate median line. In doing so, they followed a world-wide trend towards extended fisheries limits which were foreseen in the draft text of the UN Law of the Sea Conference. At the same time, the EEC decided to take over responsibility for the management of the fish stocks within its waters from NEAFC and the individual member States resigned from NEAFC. This decision could not have been taken until 200-mile limits had been declared but it also reflected increasing disillusion with the decision-making processes of NEAFC; although decisions on the size of the TACs and their allocation by quotas were agreed upon at the annual meetings of NEAFC, its objection procedure meant that these agreements were often never put into effect. There was also no procedure by which action could be taken against member States of NEAFC who exceeded the agreed quotas. The EEC framework of Community law decision-making gave the possibility of effective fisheries management.

2. THE EEC FRAMEWORK FOR DECISION-MAKING

Three Community institutions - the Council, the European Parliament and the Commission - are involved in determining TACs. The responsibility of the Commission is to initiate proposals on which the Council decides. The civil servants of the Commission (the Commission services) draft legislative proposals which are submitted by the Commissioner charged with the dossier to the Commission, that is, the 14 Commissioners acting together. If agreed by the Commission, they are then submitted to the Council. The Council consists of a representative at ministerial level from each member State; each minister attends the Council meetings which deal with the subjects for which he is responsible. Thus, there are a series of Fisheries Councils attended by Ministers for Fisheries. However, decisions concerning fisheries can be made at any Council meeting, with far-reaching consequences as will be described later (Section 5). Decisions made by the Council become Community Law. The Treaty of Rome which established the EEC lays down that, with some exceptions which do not concern fisheries, decisions within the Council are made on the basis of a system of qualified majority voting, if acting on a proposal by the Commission. However, the Council may act on its own initiative but decisions then have to be unanimous. The European Parliament has to be consulted on the Commission's proposals but its advice is not mandatory. 1/

1/ Since the agreement on the Common Fisheries Policy of 25 January 1983, this no longer applies because legislation is now based on Regulation (EEC) 170/83 of 25 January 1983 (O.J. L 24 of 27 January 1983) and not on Article 43 of the Treaty establishing the European Economic Community.

3. OBTAINING ADVICE FROM ICES

As a result of a series of 'Dialogue Meetings' between ICES and the managers of the fish stocks, i.e. representatives of the various nations within those waters the various fish stocks occur), a routine procedure of asking for and receiving advice on TACs has become established. These Dialogue Meetings were organized on the initiative of ICES.

The now-established method is as follows. Each autumn, at the time of the annual Statutory Meeting of ICES, the Commission services submit a request to ICES for scientific advice on all the stocks of interest to it. The general terms of this request are that the "Commission requests advice on the state of a particular stock and, for the next year but one (that is, the request made in autumn 1982 is for advice for 1984), estimates of catches which would be obtained for changes in the fishing mortalitiy rate of $\pm$ 50 percent of the present fishing mortality rate. The effect of these various catch levels on the size of the spawning stock biomass is also requested."

TACs and quotas are based on a calendar year, with a few exceptions. The advice for most stocks is received in the course of the year prior to that which it applies; for example, advice for 1984 is received during 1983 and this gives rise to problems of timing because, for some of the most important stocks such as those of North Sea cod, haddock whiting and mackerel, the advice is not available until November. Even more difficulty is experienced with many herring stocks, for which the advice is not received until the May of the year to which it applies, in their present state of exploitation. These problems derive from the date of availability of biological data, which prevents assessments being made earlier. It results in a very tight time-table of negotiations between the EEC and third countries (countries which are not members of the EEC). For very short-lived stocks such as sprat, sandeel, Norway pout, it has so far proved impossible to collect the biological data, make assessments, give advice and then put this advice into effect within a time-scale which allows for management; the fisheries have occurred before agreement can be reached.

In response to requests from the managers, ICES has changed its schedule of Working Group and ACFM meetings in order to provide advice on a time-scale which gives more time for implementing it, although severe problems still occur for the stocks listed above and are the cause of severe criticism of the Commission. The fishing industry needs to know the Community catch possibilities several months ahead for planning purposes, and negotiations between the Commission and the Council would possibly be concluded more readily if both parties were working to a deadline of reaching agreement by 1 January. These problems will not be resolved until the pattern of exploitation on these stocks is improved.

ICES is an entirely independent scientific organization, although supported financially by the countries which are members of it. Although most of the member States of the EEC are also members of ICES, the EEC is not a member and plays no role whatsoever in its decision-making processes.

Attendance at the meetings of ACFM is limited to its members. It can respond to requests for advice in whatever way it thinks fit, giving additional advice to that requested if it considers this necessary, or refusing to respond to the requests if it considers that there are insufficient data upon which to give sound advice. Both at the level of its Working Groups and at that of ACFM, ICES is totally scientifically independent. This is extremely important because it means that its advice is seen to be objective even if it is not always acceptable to all parties. The advice which the Commission receives now is in the form of options, 'exploratory advice', as it has been termed by Hoydal (1982). This is in marked contrast to the situation which existed until 1980, when the advice was given in terms of a recommendation for a specific TAC based upon a management objective decided by ACFM ('normative' advice - Hoydal, 1982). Largely at the instigation of the Commission, which took the attitude that it was the responsibility of the managers to decide the management objectives and not that of ACFM, the method in which advice is framed was changed. ACFM now gives advice in terms of catches which are 'within safe biological limits' or a 'preferred TAC'. Only when the stock is in danger of a recruitment failure, does ACFM give specific TAC recommendations.

There are increasing demands for longer-term predictions, in order that the fishing industry may be given the opportunity to plan, but to date ICES has been able to respond to only a very limited extent to this demand. The levels of catches from many of the stocks are so heavily dependent upon the incoming year-class that it is impossible to forecast catches until the size of this year-class has been estimated accurately and this can be done only in the year preceding that to which the TAC will apply.

Another feature of the advice given by ICES is that it is deterministic in character, i.e. it does not take into account sampling errors in the data or any other sources of variability. It could be very useful to managers in assessing the risks associated with different management options (see Section 7), if stochastic analyses were made, i.e. notably to take into account fluctuations in recruitment. So far, ICES has not adopted this approach and, to the extent that it has given predictions of long-term catch possibilities, it has usually chosen to base these on the lowest observed levels of recruitment. Predictions based on the 'worst possible case' hypothesis contain a very high safety factor but are of little use to managers as a basis for management because they are unrealistic.

4. USING THE ADVICE : OBJECTIVES

The general form in which ICES gives its advice is that of a graph showing catches as a function of fishing mortality rate. In order to decide on the TAC, it is necessary first to decide on the management objective for the coming year or, alternatively, to decide what the TAC will be for a management objective that has already been decided. As a result of the way in which the request for advice is framed, the management objective has to be defined in terms of a desired fishing mortality rate or a desired size of the spawning stock biomass. This problem did not exist when it was ACFM which decided upon the management objective and specified the TAC in terms of that objective.

The EEC is concerned with two types of stocks: those which are found exclusively within the EEC waters - the autonomous stocks, and those which occur in both EEC waters and those of another State which is not a member of the EEC - the joint stocks.

4.1 Autonomous stocks

The Council has never taken a decision about what should be the management objectives for autonomous stocks and it has, therefore, been left to the Commission to decide the basis on which it should propose TACs. Until and including 1982, its proposals were based on the following objectives:

(a) Closure of fisheries on stocks which were in danger of or had suffered a recruitment failure

(b) Achievement of exploitation at the rate of F_{max} on all stocks, by a reduction of fishing mortality rate by 10 percent each year for stocks exploited at greater than F_{max}

These were the same as the objectives set by ACFM.

As it became increasingly obvious during the course of negotiations within the Community framework that objective (b) could not be achieved, it was modified in 1982 to setting TACs which would achieve a stabilization of the fisheries at the existing level of the fishing mortality rate. Once this is achieved, then the objective is to set TACs which will reduce the fishing mortality rate by about 10 percent a year on stocks which are over-exploited, but not necessarily to the level of F_{max}. The final decision will depend upon how stocks react to reductions in the fishing mortality rate, if and when this is achieved. Both multi-species theory and energy-flow models suggest that, if F_{max} were achieved on all stocks, the consequent catches would not be those predicted on the basis of the parameters used in the existing models.

4.2 Joint stocks

In theory, there should be a management objective agreed upon between the managers of joint stocks. The most important joint stocks for the EEC are those which are shared with Norway and, at present, there are no agreed management objectives. With few exceptions, Norway adheres to the management objectives (a) and (b) as described above. The EEC and Norway therefore find themselves in conflict in deciding TACs for joint stocks because the Norwegian objectives results in lower TACs for the majority of stocks than that of the EEC. These conflicts are resolved by negotiation.

5. NEGOTIATIONS WITH THIRD COUNTRIES

For joint stocks, the TACs and the share of these available to the EEC are decided by:

(a) Direct negotiation with the other joint owner or owners of the stocks

(b) Negotiations within the International Baltic Sea Fisheries Commission (IBSFC)

or (c) The Commission itself in the one instance in the north-east Atlantic where negotiations have not been completed (Iceland)

Both in the case of negotiations directly with third countries and in the IBSFC, the Commission services have the responsibility for undertaking the negotiations, but all interested Member States are present at the negotiations and are consulted before and during the negotiations. These negotiations have two objectives:

(a) Fixing the TAC for each stock

(b) Deciding how each TAC should be divided between the different owners

The scientific advice of ICES forms the starting point of all the negotiations. To re-emphasise a point made earlier, the objectivity of its advice makes this possible. In the IBSFC, this advice is considered in relation to the stated needs of the fisheries of each member country of IBSFC until, by a process of negotiation, a final TAC and its division between member countries is agreed. In the event of failure to reach agreement, each member country determines its own quota.

The problems are fewer in the case of negotiations directly with a third country with which the EEC has a 'Framework Agreement', which requires the negotiation of an annual fisheries agreement on TACs and allocations between the two parties on the basis of reciprocity. The best example of the operation of one of these Framework Agreements is that with Norway. The EEC and Norway have:

(a) Agreed that certain stocks are joint stocks and, based upon a detailed examination of scientific data on the distribution of the stocks between the waters of the EEC and Norway, have decided on the proportion of the stock which inhabits the waters of each owner - "the agreed ownership shares", e.g. North Sea cod, haddock, whiting, saithe, plaice.

(b) Agreed that certain species, although occurring in the waters of both owners, should be treated as autonomous stocks for the purposes of management, e.g. sprat, Norway pout.

(c) Agreed to differ on certain stocks which the EEC claims as an autonomous stock and Norway claims as a joint stock, e.g. the western mackerel stock.

It has only been possible to agree on ownership shares for those stocks for which very detailed scientific data exist on their distribution, as shown by catches and egg, larval, O-group and young-fish surveys.

For those stocks for which there is an agreement on the ownership shares, the share of that TAC available to each party is automatically decided once the TAC is agreed. This does not give either party the catch possibilities it wants. The EEC needs more than its agreed share of North Sea cod, haddock, saithe and whiting. It also needs catch possibilities in the Barents Sea stocks of cod, haddock, saithe and redfish, to satisfy the needs of the distant-water fleets of France, Germany and the UK. The stocks in the Barents Sea are joint Norway/USSR stocks, for which those two countries have to enter a similar set of negotiations. Norway is, therefore, limited as to what it can allow the EEC to fish of these joint stocks by its agreement with the USSR on the size of its shares. Norway wants to catch a wide variety of species in EEC autonomous stocks. These requirements are met by negotiating trade-offs between the various autonomous stocks.

To facilitate these exchanges, the EEC and Norway have agreed on a series of 'cod equivalents' which weigh the tonnages of the different species in terms of their relative market values, approximately. For example, 1 ton of cod is equivalent to 0.87 tons of redfish and to 0.77 tons of saithe. These agreed cod equivalents mean that an equitable balance can be struck very easily, without having to re-negotiate each year how much one species is worth relative to another.

While it does take hard bargaining to decide how much each side is prepared to allow the other from either its share of the joint stocks or its autonomous stocks, the framework in which these negotiations takes place has already been decided and this facilitates the negotiations.

In the case of Iceland, with which negotiations have not been successfully concluded because it does not allow EEC vessels to fish in Icelandic waters, except for Belgian vessels covered by an old but still operative agreement, the EEC unilaterally decides its share of any joint stocks. Although there is no agreed division of the joint stocks, discussions at both the scientific and negotiating levels have taken place as to what these might be, so preparing the ground for a future "Framework Agreement".

A final point is that all the coastal States involved have more than the capacity to take the TACs. Therefore, negotiations over surplus catch possibilities do not take place with countries outside whose fisheries limits the fish stocks occur.

6. ALLOCATION BETWEEN MEMBER STATES OF THE EEC

After all the negotiations have been finalized, the EEC has a list of catch possibilities (TAC) in five different types of stocks:

(a) Its own autonomous stocks, all of which are available to the EEC

(b) Its own autonomous stocks, parts of which have been traded for catch possibilities in autonomous stocks of a third country or for additional catch possibilities in a joint stock, as described above

(c) Joint stocks, in which it has negotiated TACs and its share of the TACs, as described above

(d) Autonomous stocks of one or more third countries

(e) Stocks outside exclusive fisheries limites, e.g. NAFO stocks

The sum of all these catch possibilities provides the total EEC catch possibility for the calendar year.

The TAC is the management tool but the TAC has to be divided into quotas between Member States, for two reasons:

(a) Effective management is impossible if the TAC is not divided into quotas, because the fishing boats of each Member State would otherwise compete in order to maximize their share of the TAC before it was exhausted, leading to disruption of the industry once the fishery was stopped

(b) Member States want to have guaranteed shares of the TACs in order that they can plan their fleet development, marketing, etc.

Proposals for the allocation of TACs by quotas are prepared by the Commission services. They are based on criteria which were formalized by a Council declaration in May 1980 on the Common Fisheries Policy, which stated that the policy should be based on, inter alia, the following guidelines:

> "Fair distribution of catches having regard, most particularly, to traditional fishing activities, to the special needs of regions where the local populations are particularly dependent upon fishing and the industries allied thereto, and to the loss of catch potential in third country waters (Official Journal of the European Communities, No. C 158 of 27/6/1980, page 2)."

In allocating quotas, the Commission has interpreted these guidelines as follows:

(a) "Traditional fishing activities": average catches in the period 1973-78, less industrial by-catches beyond permitted limits and human consumption species caught directly for reduction to meal and oil.

(b) "Special needs of regions where the local populations are particularly dependent on fishing": these regions had been defined by the Council as Greenland, Ireland and north Britain (the so-called "Hague Preference" areas, after an agreement by the Council reached at the Hague in 1976) and the special needs were interpreted by the Commission as:

- For Greenland: a major share of the catch possibilities in Greenland waters
- For Iceland: doubling of the 1975 catches by 1978
- For north Britain: maintaining a minimum catch possibility equal to the landings in 1975 by vessels less than 24 m long at ports in northern Ireland, Scotland and along the east coast of England as far south as Bridlington

(c) "Loss of catch potential in third country waters": the difference between what a Member State is actually allowed to catch and what it would have caught if there had been no extension to 200-mile limits. What it would have caught is calculated as its average percentage share of the particular stock for the period 1973-76 multiplied by the TAC, if known, or the estimated TAC, otherwise.

This declaration was made by a Council of Foreign Ministers. It made no mention of how much weight was to be placed on each criterion.

The Commission services developed a mathematical model which took into account the three criteria. The results from this model, however, only served as a starting base for the allocation of quotas, stock by stock. Member States wanted not only to have specific proportions of each TAC but some Member States also demanded specific proportions of the total catch possibilities. The situation was further complicated by the fact that some demands were made in tonnages and others in percentages. This had a potential "gearing" effect because, if the proposed quota of one Member State had been increased by a specific tonnage, which would also have increased the TAC by a similar amount, the quota of a Member State which had demanded a specific percentage of the TAC would also have been increased. For this reason, the Commission resisted such demands and negotiated within the TACs for each stock and the total of these TACs.

Until the agreement on the Common Fisheries Policy, the Council had never been able to agree on the quota proposals put forward by the Commission and had only once, in 1980, agreed on the TAC proposals. Each Member State naturally emphasized that part or parts of the Council declaration which suited it best. Those Member States which had no distant-water fisheries and which did not include areas especially dependent upon fisheries saw no reason why their traditional fisheries should be disrupted by being made effectively to transfer fish to other Member States who benefited from one or other of the other two criteria. At the same time, the two Member States which had suffered most from being excluded from third country waters objected to the inadequacy of the compensation which they were being offered. Ireland considered that its fisheries should continue to be allowed to expand after 1978, even though the stocks on which it fished were over-exploited and such expansion could be achieved only by either allowing increased over-exploitation or transferring fish from other Member States.

The whole argument took place against a background of steeply rising fuel prices and stagnating market prices. Between 1973 and 1981, fuel prices in the EEC rose by the order of 1,000 percent whereas the average price of fish, in real monetary terms, rose by probably less than 200 percent. In the same period, interest rates peaked to 15-20 percent. One of the few ways which the fishermen could see to overcome their problems was to be allowed to catch more fish. Ministers in the Council were under intense political pressure not to agree to any proposals which would result in smaller catch possibilities for their fishermen and to increase them if at all possible.

The Commission was determined to maintain its responsibilities in respect of conservation of the fish stocks and refused to table proposals which would allow fishing to expand. In this it was usually supported by the UK and Ireland, which took a strong stand in respect of the advise given by ICES. However, for domestic political reasons, the UK was trying to obtain a fisheries package which included a whole series of preferential rights over much of its waters within its fisheries limits. The UK insisted that the package had to be agreed upon as a unity and would not allow TACs and quota allocations to be agreed to separately. It was able to do this by declaring that fisheries was of vital

national importance and invoking the "Luxembourg compromise". At Luxembourg in 1966, it was agreed not to out-vote a member State whose declared vital national interests were affected.

A Common Fisheries Policy was eventually agreed upon on 25 January 1983. Three key elements were involved. Firstly, the stumbling block of the question of access by one Member State to the waters of another was satisfactorily resolved on a long-term basis, thus enabling the UK to agree to other measures. Secondly, the Commission tabled proposals that give the quota proposals of 1982, if accepted, 'staying power' (see Section 7). Thirdly, by making minor increases in the TACs for some autonomous stocks and one major increase, and by negotiating with Norway increases in the TACs for certain joint stocks, the Commission was able to improve the catch possibilities for the EEC in 1982. As a result, it was able to table a set of quota allocations which (a) were in accordance with its management objectives, and (b) met by the criteria of the Council declaration of 30 May 1980.

The one major concession which the Commission had to make was to increase the TAC for the western stock of mackerel (that inhabiting the sea area west of Scotland, west and south of Ireland, western English Channel and the Bay of Biscay) from the 272,000 tons recommended by ACFM to 401,000 tons. This stock is being rapidly depleted and it is predicted that it will suffer a recruitment collapse in approximately four years' time if fishing on it is not severely limited. At the same time, it is one of the most important EEC stocks, particularly as it is one of the few stocks which can be exploited by distant-water vessels which can no longer fish third-country waters. The Commission was faced with the predicament that, if it had not increased the TAC on this stock, agreement on TACs and quotas would almost certainly not have been reached. With no agreement, free fishing on the stock would have continued and predicted catches in 1983 in this case were 750,000 tons.* The agreement in 1982 will result in more effective conservation than if a lower TAC had not been agreed upon.

7. PROBLEMS OF ALLOCATION IN THE FUTURE

The principle of allocation of quotas is laid down in the regulation which establishes a Community system for the conservation and management of fisheries resources, the so-called 'Basic Regulation (Regulation - EEC - No. 170/83 of 25.1.83). Under this regulation "catches available to the Community ... shall be distributed between Member States in a manner which ensures relative stability of fishing activities on each stock considered". This implies that, generally speaking, the quota in each stock for each Member State will be the same percentage of the TAC for the current year as that agreed upon in 1982.

However, there are still three problems which face the EEC: (a) the establishment of TACs for autonomous stocks, (b) the specific problem of the western mackerel stock, and (c) allocation of quotas in the herring stocks.

As stated, in Section 4.1, the EEC has not got agreed management objectives for the establishment of TACs. Until the Council can agree on what the objectives will be and also on the long-term strategy and the way in which it is to be implemented, it appears inevitable that there will be an extended round of negotiations within the Council each year on the exact level of TACs. The situation will become particularly acute if there are big declines in one or more of the major fish stocks. There will be little point in having an automatic mechanism for fishing quotas if the EEC cannot agree on TACs.

The EEC will have to face this problem for the western mackerel stock in 1983. To continue to exploit the stock at its present rate will result in its inevitable collapse, with the consequent collapse of the fishing fleets which are largely dependent on the stock. To avoid this, the EEC will have to decide on the extent to which short-term benefits from exploiting the stock at a higher rate than it can withstand can offset the long-term benefits of cutting back the fishery drastically.

Alternative catch possibilities in the recovering stock of herring may enable the required reduction in the TAC to be made. Otherwise, the EEC will be faced with a severe test of its responsibilities in fish-stock conservation.

Because many of the herring stocks in Community waters were either unable to support any fishing or only limited fishing in 1982, allocation of quotas between Member States was 'ad hoc'. For this reason, it has been agreed that these allocations cannot be used as a basis for allocating quotas in future years. Although the Commission has proposed several ways in which the criteria of 30 May 1980 could be used to allocate future quotas, none has proved acceptable as yet.

Considering the longer-term future, it appears that the method of deciding upon TACs must evolve, if not their allocation by quotas. The demand for long-term forecasts implies that recruitment will have to be treated stochastically rather than deterministically, as mentioned in Section 3. This carries the implication that decisions will have to take into account the degree of risk associated with different courses of action. The Commission has already taken a step in this direction (Beddington, 1982). There is also the possibility of managing interacting fisheries and species interactions, by setting TACs which will attempt to maximize economic returns. For example, would it be more profitable to stop certain sprat fisheries in order to prevent the inevitable by-catch of young herring and thus to increase the yield from the herring fisheries?

8. ENFORCEMENT

The EEC has yet to face up fully to the problems of enforcement of quotas. Member States are obliged to submit to the Commission the catches of all fish species which are under TAC and quota regulation by the 15th of the month following their capture. The original regulation which required this was Council Regulation (EEC) No. 735/80 of 26/3/1980, which was superceded by a Control Regulation (Council Regulation (EEC) No. 2057/82 of 29/6/1982 on 1 January 1983). The Control Regulation also commits Member States to stop fisheries on stocks once their quota is exhausted. The Commission has to be informed and then will make a regulation to close the fishery, thus ensuring Community competence in the management of fish stocks. Alternatively, the Commission can do this independently of the Member State if it considers that the quota has been exhausted.

In those cases in which the EEC has an agreement with a third country concerning its share of the TAC, and this agreement has the force of Community law because it is embodied in a regulation agreed to by the Council, the EEC has to stop the fishery once the EEC's agreed share has been caught. This is done by monitoring catches, using the catch reporting system described above. The delays in this system plus the delays in getting legislation into force (five working days at minimum) mean that the EEC share of the TAC may be considerably exceeded. Besides being administratively inefficient in ensuring effective control, it is also practically inefficient as the regulations are introduced at very short notice with the possibility of severe disruption of the industry.

If fisheries management by quotas is to become acceptable, a more rational method of stopping fisheries is required. Firstly, Member States should take measures to ensure that their quotas are caught at a rate which will largely avoid the need to stop fisheries. Secondly, by taking into account the pattern of the particular fishery in previous years, they should predict the date on which the quota is likely to be exhausted, so that measures can be prepared well in advance and the industry warned of the closure date a month or more beforehand. The Commission services are already working in this direction. Member States which exceed their quotas will be liable to be taken before the European Court by the Commission.

9. SUMMARY

In taking over responsibility for fisheries management in its waters from NEAFC, the EEC considered that it could provide more effective management. Up until 25 January 1983, it had been unable to do so, although it was almost certainly true to say that NEAFC would have done no better under the circumstances. With the establishment of the Common Fisheries Policy, it has the possibility of doing far better.

In contrast to NEAFC, once an agreement is reached at Council level, it is Community Law, applicable in all Member States, unlike the NEAFC agreements which needed to be implemented by national legislation.

Over the last three years, the EEC has been able to change the system of giving advice to one which is more suited to its needs. This has now become a matter of routine which presents few problems. Additionally, ACFM has ensured that Working Group reports contain all the basic data upon which the assessments are based, so examination of the results of alternative strategies can be made. As yet the Commission services have failed to exploit this possibility, for lack of both human and technical resources.

Negotiations within the Council have been characterized by a determination on the part of each Member State to maximize both the TACs and the share of these TACs allocated to it. This is not surprising, given the political pressure on the Ministers of the Member States from their fishermen, who are severely stressed economically.

The problem of setting TACs will remain until the EEC can agree on a set of management objectives. This is likely to prove difficult because the fisheries of the EEC are "open access". New problems are likely to arise. Enforcement of quotas will certainly bring increased problems of evasion and cheating; these are already occurring, to the extent that they are threatening the whole basis of scientific advise because accurate catch data for some stocks are no longer available. If this continues, it could wreck the whole foundation of fisheries management based on scientific advice.

A range of control measures will be in force but the history of fisheries is that fishermen have usually found it easy to circumvent control measures because of the nature of fisheries.

These problems may be alleviated to a certain extent because there is money available under the EEC's structural policy for scrapping surplus vessels and laying up boats for which there are no immediate prospects of employment. However, this will not stop fishermen entering the fisheries or improving the catching power of their boats, if they can secure the necessary finance from non-governmental organizations and they think that the investment is worthwhile.

On 25 January 1983, the EEC solved most of the problems associated with establishing a fisheries management system based on TACs and quota allocations. That was a success story in itself. However, the EEC will be unable to rest on its laurels because it is now faced with the problems of running this system.

10. REFERENCES

Beddington, J.R., 1982 Economic studies on the implications of re-opening the North Sea herring fishery. CEC Internal Inf.Fish., (11)

Hoydal, K., 1982 From normative to exploratory advice on fishery management and the general framework of advice. ICES CM 1982/Assess. 5:21 (mimeo)

THE PROBLEMS OF QUOTA MANAGEMENT IN THE EUROPEAN COMMUNITY CONCEPT

by

P.J. Derham
Chief Inspector of Fisheries
Ministry of Agriculture, Fisheries and Food
Great Westminster House
Horseferry Road
London SW1P 2AE, UK

1. INTRODUCTION

Concern that the marine resources of the North-East Atlantic area should be protected from over-exploitation and conserved to ensure their continued and sensible utilization in the future has been voiced for many years. Indeed, the North-East Atlantic Fisheries Commission was established with this purpose in mind. Initially it recommended certain non-quantitative conservation measures such as limiting mesh sizes of nets and these were adopted on a unilateral basis by Contracting States. It then introduced total allowable catches for those stocks which were considered to be at risk, on the scientific advice of the International Council for the Exploration of the Sea, and again these were put into effect on a national basis. However, there was little if any, attempt by the NEAFC to restrict expansion of fishing potential and, in the event, the results of the consentient approach were disappointing. At the present time most of the commercially attractive stocks of North-East Atlantic fish are over-exploited. It can be seen that far too many fishing vessels are seeking too little fish, with the result that their owners are finding it increasingly difficult to operate profitably and to prosper. The European Community seeks to redress this situation with the adoption of a Common Fisheries Policy which, in general terms, continues to vest hope for the future in the TAC concept supported by traditional non-quantitative controls, but also appreciates the problems of excess fishing potential.

2. PURPOSE

This paper seeks, against this background, to review the range of seemingly insuperable problems encountered in attempting to put TAC policies into operational effect. It also considers the practicalities of quota management but does not deal with methods of quota assessment or national allocation, nor the pros and cons of the TAC concept as an effective conservation tool. While the considerations and difficulties described are related to the North Atlantic experience in general and the European theatre in particular, they are nevertheless considered to be equally applicable in principle and practice in any other area where TACs might be employed.

3. THE EUROPEAN QUOTA SITUATION

In the European Community situation, TACs cover stocks which are not only shared by the nine fishing Member States but also by neighbouring countries such as Norway, Sweden and the Faroes which are not Community members. They are shared in the form of quotas negotiated within the Community against an agreed percentage allocation based on their historical fishing performances. This is also the general basis for apportioning shared stocks with Third Countries, although consideration of mutual access and fishing opportunities in each others' waters is taken into account in negotiating these. European Community residual stocks are allocated only to Spain, but access to the grounds is limited in terms of catch and effort. The overall scenario is complex, particularly when overlaid with unilateral measures. It is therefore a useful area of study.

4. RESPONSIBILITY FOR ENFORCEMENT IN EC WATERS

While all Community vessels are subject to common conservation measures, these are not enforced by any centralized Community agency. Each coastal Member State is required to establish an Inspectorate and retain sovereignty over its waters within the Community "fish pond". It bears the responsibility for enforcing all non-quantitative measures upon all vessels of whatever nationality which fish within its waters, while monitoring and control of national quotas remains the responsibility of each Coastal State wherever its vessels may be operating. To overcome inevitable doubts in the minds of fishermen, that nations other than their own may not be operating this arrangement conscientiously, a statutory common reporting procedure has been imposed. This requires the maintenance of fishing logs and/or declarations of landings by all Community vessels over 10 m in length. Each Coastal State is required to monitor its quota uptake effectively and to report results at monthly intervals to a central monitoring unit which informs all Coastal States when a national quota has been filled and that country's vessels should have stopped fishing for it. It also reports in this way when the overall "Community" quota for any particular species has been filled. Then all Community vessels must stop fishing forthwith, regardless of any individual country shortfall. Clearly, if this situation should occur, the community monitoring system will have failed to detect that one or more Coastal States had exceeded their national quota. So far this contingency has not been contemplated nor agreement reached as to any disciplinary sanction which might be imposed on the Coastal State concerned. This might include, for example, imposing a comparable reduction in that State's next years' quota.

Prohibition of any continued fishing for species for which the quota has been filled returns to the responsibility of the coastal State in whose waters such illegal activities are seen to take place. A Community Inspectorate of Inspectorates has been formed to oversee effective and harmonized national enforcement of Community Conservation Regulations. It is hoped that this will contribute substantially to the success of the Community's conservation policy. However, experience in the past does suggest that even this approach will fail to overcome the totality of the practical problems inherent in a TAC quota system. Indeed the extent and complexity of these does question their viability as an effective management tool in favour of what in the first instance may erroneously seem to be less complicated non-quantitative measures.

5. GENERAL OBJECTIVES OF QUOTA MANAGEMENT

Clearly the primary objective of any Flag State must be to systematically monitor its vessels' uptake of each species subject to quota and ensure that directed fishing is stopped as soon as any quota has been reached. The universal application of these aims should then ensure reasonable adherence to the guidelines suggested by the previously negotiated total allowable catch figure.

There are, also, extremely important unilateral aims which have to be met by each Flag State within the context of their national quota allocations. These often carry severe political implications and they generally lead to extremely complex procedures which are difficult and costly to implement. First, there is a responsibility to ensure that the quota allocated to the Flag State is utilized sensibly and to best economic effect. Next, the national authority may feel it should also cater for the needs of the processing and distribution sides of its fishing industry, possibly endeavouring to do this by tuning fishing to avoid market glut and trough conditions. Finally, the national authority will have to ensure that opportunity to catch the quota species is shared equitably throughout all the appropriate sections of its national fleet.

6. DATA ACQUISITION

The degree with which these objectives are achieved and indeed the success of the quota regime imposed will largely depend upon the effectiveness with which the fishing operation can be monitored. Indeed in essence quota management is a data acquisition excercise and clearly the establishment of an efficient data-processing system is a pre-requisite of any quota management and control policy. Quotas are established on TACs which are calculated on the basis of live weight and set on a stock basis. The base data elements required are therefore what fish was caught where or, in other words,

what are the details of the catches of each individual vessel, in terms of the quantity of each species taken from the sea related to the position in which each vessel was operating. Ostensibely this is a simple accounting exercise but in reality is far more complex, because of the inherent difficulties which militate against the effectiveness of monitoring these base data elements to any acceptable degree of accuracy. This applies not only to achieving the first objective of quota management but also particularly in meeting the secondary ones which overlay it. When formulating any quota management policy, it is necessary to create conditions which not only facilitiate the acquisition of the necessary data but above all also go as far as possible to ensure a reasonable probability of accuracy. Inevitably this will create a demand for the enforcement of reporting procedures and surveillance, which in itself creates its own range of problems.

7. DATA FROM LANDINGS

7.1 General

Ostensibely the most sensible and convenient point at which catches may be monitored is at the port of landing. But the overall effectiveness of doing so will be inversely proportional to the number of stations to be covered, because of the manpower implications involved. Clearly the fewer there are the better will be the results. It suggests that a fundamental requirement of any quota regime is the limitation of the number of permitted discharge ports and this indeed is so. Conversely, if the number of designated ports is reduced, all remaining and undesignated ports must be checked to prevent unauthorized and undisclosed landings. Solving this question in itself calls for a difficult administrative decision as to the degree to be drawn between determination to enforce quotas and the costs involved in what could become a fairly labour-intensive exercise, and incidentally is a good illustration of a dilemma which emerges frequently in quota-management situations.

7.2 Foreign Landings

Landings abroad create especial difficulties but foreign ports may sometimes have to be included in any authorised list if market opportunities elsewhere are sparse. It is a situation which calls for bilateral arrangements to be made with the foreign authorities concerned, in which they undertake to report details of any landings, whether legal or not, which have been made, as quickly as possible to the Flag State concerned. Hopefully, they will also be prepared to provide evidence in the Courts of the Flag State, should legal proceedings prove necessary. Landings at undesignated ports can also be countered by imposing conditions on skippers to seek prior permission to land anywhere and to declare the intended quantity of fish to be discharged. This requirement may then be effectively coupled with spot checks of the vessels' catch on board, immediately prior to landing or transhipment, but raises the problems of assessing quantities of fish in a fishing vessel.

7.3 Objection to Designated Ports

Objections to the limitation of landing points may arise from catchers, on grounds of unreasonableness. Owners of small fishing vessels may, for example, complain of their inability to get to and work from designated ports by virtue of their size. Other skippers may lament the alleged wastage of fuel involved in steaming to and from the fishing ground or the lack of market outlets afforded at the designated ports. All of these charges will have to be considered carefully and reasonable derogations granted as necessary, taking into account as always the possibility in such cases of alleged favouritism and political implications.

7.4 Small Ports

In some circumstances it may be completely impracticable and even politically unacceptable to designate a specific number of landing ports. This may well be the case where a quota fishery is prosecuted wholly or in part by a large number of small craft plying from a myriad number of small fishing stations. Generally the effort required to collect data on a census basis in such circumstances will exceed available resources and it will be necessary to adopt compromise solutions such as sampling the catch at selected typical ports and rounding this up in accordance with the number of boats known to be operating in the area.

7.5 Linking Catch to Area

As already suggested, the best quota-management condition probably occurs where all vessels land at one or two ports where their catches are weighed accurately. But even in these circumstances two particular problems arise. First of all, there is no certainty of the position where the fish was caught and reliance for this information will have to be placed upon statements of the fishermen concerned, supported by the Inspectors' knowledge of local seasonal fishing patterns. An out-turned catch could consist of catches from several grounds or separate quota areas but it will be practically impossible to say with any certainty from which area any particular quantity may have come. It is a difficult question and indeed represents one of the over-riding dilemmas of quota enforcement. A fisherman can always claim that he caught his fish outside a quota area. It is a major loophole which unfortunately gives considerable weight to the argument that quotas are unenforceable. Certianly it is very difficult to close this opening even with good surveillance and on board inspection. For example, it is difficult to prove beyond reasonable doubt that a vessel was actually fishing from aerial observation and of course it is impossible to show what she was fishing for when observed. Even if full of quota fish when inspected on board, her skipper can claim with considerable if not complete imunity that he caught it in some other area. Further he can, and understandably will, claim that any illegal fish in his last haul was caught unavoidably and that he intends to dump it. The range of plausible defences put forward by fishermen in exploiting this loophole is proverbial. Few are easy to refute and, in some despair, Inspectors sometimes claim that perhaps the only effective way of stopping it is to invoke a legal assumption that any fish on board a vessel was caught in the vessel's present position unless proof is provided to show otherwise. This is of course not possible in many legal systems and does not in any case solve the problem of discerning at a port of landing where the fish was caught.

7.6 Establishing Live Weight

The second problem in attempting to monitor quotas at the landing point arises from the fact that quotas are established in terms of live weight caught. The weight of the catch when it is landed will be less than that when it was caught for a variety of reasons. These include the fact that there will have been a rejection of small or otherwise unwanted fish at the point of capture. Also, depending upon species and the custom of the landing port, the fish will be landed in a variety of presentations. It may, for example, have been filleted on board, frozen in consumer packs or reduced to fishmeal and will inevitably have leached some of its natural juices. Any of these factors may have contributed significantly to the difference between the weight of the fish caught and that when it was landed, so that appropriate conversion factors have to be applied to each particular presentation in order to obtain an assessment of live weight. Conversion factors will vary according to species, the biological state of the fish, the particular season and the grounds on which the fish was caught. They are a matter of some contention and should be established and applied only by general agreement.

7.7 Volumetric Measure

Returning to the quantity landed, it should be recalled that not all landings are necessarily weighed. Thus it is often difficult to establish even the apparent weight of the fish that was landed. Traditionally, fishermen tend to describe their catches in terms of some convenient container such as a basket or box and they consider them in volumetric rather than weight terms. The difficulty is exacerbated by the fact that catches may be discharged in what are described as, say "50 kilogramme boxes", but, as these may be filled with a mixture of fish and ice of varying proportions, they are likely to have a wide variation in quantity of the fish they contain. Further it is often the custom of the fish trade everywhere to provide a "baker's dozen of thirteen loaves" by overfilling containers in order to please regular buyers and to compensate for eventual drainage and other losses. It is also not unknown for skippers to attribute a variety of weights to their boxes for different purposes such as the payment of harbour dues and the claiming of subsidy. Given the range of such circumstances, it is obviously advisable to build into any quota scheme a definite requirement that all fish landed should be weighed, notwithstanding the possibility that universally traditionalist and conservative fishermen will resist.

8. LOG BOOKS

With the present exception of objective observers embarked in each fishing vessel, fishing logs probably afford the most practical means of recording the basic data elements required in quota monitoring. The value of the log book will obviously depend upon the accuracy with which it is kept.

Conscientiously maintained, it should provide in one form or another the date, time and position of the vessel at each haul (preferably in terms of a convenient grid covering the quota area) and, most importantly, the skippers best estimate of what each haul contained. When the total catch is discharged its weight can be accurately ascertained and corrected to live weight and in turn apportioned to the appropriate quota area in accordance with the skippers' estimates. It is perhaps unnecessary to point out that a skipper can generally provide only estimates of this catch which will be based on his experience of the weight discharged on previous landings. Weighing on board is impractical on most fishing vessels because of the inertial effects on weighing machines which are caused by the movement of a vessel in a seaway.

9. VALIDITY OF LOG BOOK INFORMATION

Ensuring conscientious and truthful maintenance of fishing logs is an obvious problem for any enforcement agency. One might reasonably expect that fishermen would be inclined to under-report their catches, especially if they are on a tight or even uneconomic individual vessel quota. This being the case, there is an obvious need to establish some form of deterrent which will discourage such malpractice. The ultimate of all threats to a fisherman - that he may lose his fishing licence or even that it may be temporarily suspended if information is not properly provided - may be sufficient. However, to effect such a threat in reasonableness will require fairly firm evidence of wilful negligence, even if invoked as an administrative punitive measure. In practice the deterrent will most likely be best created by an effective aerial survaillance and on-board inspection programme linked with spot-check examinations of landings.

10. INSPECTIONS AT SEA

Inspections at sea should be undertaken only by experienced and well-trained officers who are skilled in assessing catch on board. Their principal inspection function will be to check comparability of the details recorded in the log book with the catch actually on board. They will face the same problems as the skipper in making assessments but will not have the benefit of his experience. It is a task which is perhaps the most difficult and onerous of any which are encountered in fishery enforcement. There will always be room for argument as to the real quantity on board and ultimately this can only be resolved by landing the catch and weighing it. Ideally the skipper will himself elect to do this, but ordering a vessel to leave the fishing grounds to do so can have serious consequences which an Inspector is advised to consider carefully before doing so. If in the event the weighing shows no discrepancy, the Inspector may well find himself open to civil and even criminal proceedings for failing to exercise his powers with reasonable skill and care despite any immunity he may be afforded in law. There may well also be claims for compensation for alleged spoilage of the catch through unnecessary handling. On the other hand, it is not unknown for fishermen to over-estimate their catches. This can happen where there is very rigorous and even unreasonable enforcement. Skippers do not want trouble and have a deep-rooted concern over hazarding their livelihood and ability to meet financial commitments. Incidentally they may also over-report when hoping to establish a prescriptive historic background for some future quota-allocation negotiations.

11. ASSESSING CATCH ON BOARD

It is perhaps interesting to consider some of the problems faced in seeking to assess the catch on board. Factory vessels usually carton and weigh their product, which does facilitate assessment, but the examination can be very time-consuming. It has to be undertaken in conditions of very low fish-room temperatures and poor light. It also involves awkward measurement of high-rise stowage, for comparison with hold capacities shown on the ship's general arrangement plans, and sample checks on the individual carton weights and species content. In fresher trawlers the problems are eased by boxing, especially with regard to appraising catch composition. But, as noted earlier, estimation of weight is complicated by the ice content of boxes and the lack of weighing, although attempts are often made to weigh on a sample basis. More severe problems are encountered when the fish is bulk stowed in fish pounds, which are rarely cuboid in shape and vary in form according to the moulding of the hull. Even with an idea of relevant stowage factors the calculation of volume of each pound is complicated and in fact rather impractical.

Estimation must in the end depend greatly on the expertise of the Inspector. Identification of species composition is also a problem, since there is little if any room to turn over the fish to see if illegal species have been overstowed. Industrial fishers, which is to say those vessels fishing for species destined for reduction to meal or oil, are almost impossible to examine. Fish is carried in tanks. It is often chemically treated and rapidly becomes a soup of indefinable recipe. It is also virtually impossible to obtain a meaningful sample which might be used for assessment. There is, incidentally, a distinct danger from noxious gases to any Inspector entering partly filled tanks in these vessels. Bulk catches in viviers or refrigerated sea-water tanks are also almost impossible to assess with accuracy. Here again the advantage will lie with the skipper, with his knowledge of his vessel, and it is often considered necessary to require that these vessels when fishing for quota species should carry tables showing the calibration of their tanks. A technique has been evolved whereby these can be used in conjunction with tank dipping to ascertain the level of fish in the hold. Again the results are difficult to prove without weighing and are open to question. There are, for example, a number of ways in which a skipper can confuse an Inspector in these vessels. These include using his circulating machinery to stir up the tank contents and make dipping useless.

12. LANDING DECLARATIONS

European Community vessels under 17 metres but over 10 metres in length are required to declare the weight of fish landed and the position of capture within 48 hours of landing. These must be supported by documentary evidence such as sales notes. Log books have not been prescribed for these vessels since it was argued that such would be largely impractical and an imposition on such craft which are often open to the elements. The difficulties of this arrangement are that, apart from the difficulties which will be shared with those vessels required to keep log books, there will be a reduced opportunity for spot checking procedures. Landings will have to be checked at the time they are made, the data recorded and then compared with the declared figures submitted not less than 48 hours later. Earlier experience of landing declarations, coupled with pilot studies of this particular scheme, have shown that a major enforcement problem is presented. Fishermen will be reluctant or forgetful in making the returns and it is anticipated that the effort and resources required, to enforce the requirements that they should make the return on time and in accurate form, will be disproportionately high. In the EC programme vessels under 10 metres will not be required to make returns. Catches from this group will be covered by sampling techniques as described earlier. It is perhaps interesting to note that the EC programme is geared entirely to quota-control requirements. It will not generate details of non-quota species catch and will therefore deny fisheries scientists the data they need to assess the time when other species may be at risk and in need of control. The system will also fail to provide essential economic information that is based on first-hand sale prices.

13. OBSERVERS

It is known that a large measure of success in combating the basic problems of quota control has been claimed from the use of observers embarked in vessels fishing in north-western Atlantic waters. These are not seen as practical in the European Community context because, in the first place, the size of the accommodation in the vessels concerned is so small and trip lengths so short that the cost-effectiveness of such a system would be in question despite the laudibility of its objectives. The problems of recruiting sufficient staff of the essentially high calibre and expertise who would be prepared to accept the expected hard living and dietary conditions, coupled with the logistical problems involved, are likely to be almost insuperable in the particular circumstances which obtain in the area. However, their use in the quota-controlled pelagic fishery, which takes place in the UK and which involves transhipping extremely large quantities of fish directly from fishing boat to anchored factory vessel or klondykers, is considered likely to be a very useful and cost-effective option.

14. MIXED FISHERIES

It will be appreciated that, for illustrative purposes, the foregoing discussion has really been in the context of a single quota species. In most cases, of course, catches generally consist of a number of quota control, species caught at the same time. This presents few additional problems in itself, when the quotas for all the species concerned remain open, but considerable difficulties arise when the quota for one species normally caught with several others is closed while the others remain open. This

occurs particularly in regard to demersal species where, although it is sometimes possible to adjust fishing gear or move to other fishing grounds to reduce the possibility of catching a closed species, it is obviously impossible to avoid catching at least some. This situation leads to a number of administrative dilemmas. For example, should fishing for an open and profitable species be stopped because the unavoidable by-catch of protected species is too high and contributing significantly to the continuing decline of its stock. All present difficult problems which have to be dealt with in the light of local circumstances. Should retention of a by-catch of the closed species be permitted while fishing for the species which are still open continues, or should the retention of any by-catch of closed species fish even taken incidentally while fishing for other species be prohibited and required to be immediately returned to the sea - an option which was in fact adopted recently by the European Community - despite the complaints of fishermen that the fish is dead on return to sea and therefore that the practice contributes nothing to the conservation cause.

It is an interesting problem, which lends further force to arguments which allege the unenforceability of quotas. Seen purely from an enforcement point of view, returning to the sea is the only sure practical solution to this problem in the circumstances of individual-stock TACs. It will be overcome finally only in the unlikely event of a TAC being set for each group of species rather than by a particular stock. Permitted by-catches are extremely difficult to enforce because of the insuperable problems of quantifying the by-catch in terms of the total catch on board. Whatever level of permitted by-catch is set, it is quite possible early in the trip that only the quota species have been caught and therefore constitute 100 percent of the total catch on board. Only further fishing will reduce the percentage further and the question arises as to when it is reasonable to consider that infringement has occurred.

The difficulty of assessing the by-catch does differ from species to species and regulations can be drafted prescribing that the by-catch can be determined by sample. However, unless the size and method of taking it is specifically described in legislation, it is very difficult to produce a sample which is always accepted by the Courts as being representative of the whole catch. Reliance may also be placed on assessment of the composition of the whole catch and the difficulties of this have already been discussed. Nevertheless, it is prudent to draft rules that allow this as an alternative because, in cases where, for example, the catch is boxed by species, it is quite possible to take samples which will show that the catch is both legal and illegal.

15. ADJACENT STOCK QUOTAS

Problems of by-catches are made even more difficult when, as in the case of one EC quota region, different quotas are applied to small adjacent stock allocations. In that particular case, some five different stocks are variously disposed through some eight different areas. This is overlaid with the unilateral quota management regime which seeks to spread the various quotas on a quarterly seasonal basis, allowing a further 10 percent by-catch carryover from season to season. Such an arrangement can be seen as unenforceable in practice terms.

16. NEED FOR CAREFUL DRAFTING OF REGULATIONS

It will be appreciated from this discussion that the need for careful drafting of enabling legislation is paramount, if successful quota management and the enforcement of controls is to be achieved. It is a useful axiom that all regulations should be religiously scrutinized as to their enforceability before their final adoption. This applies throughout the total spectrum of fisheries legislation but, in the context of quotas, it is illustrated in the problems which can arise from the simple use of the phrase "fishing for". Taking the hypothetical case where, say, the quota for mackerel has been closed, it is logical to set-out a regulation which simply prohibits "fishing for mackerel". But mackerel is often likely to be caught jointly with sprats or horse mackerel or pilchards, all of which are not protected. Thus, if mackerel is found on board a vessel by an Inspector, a fisherman can claim that he was in fact fishing for sprat and that he had no intention of fishing for mackerel. It is impossible to prove in a Court that this was not true, and again the requirement to return the closed species fish to the sea would seem to be the only logical answer. However, following the pattern that whatever is done to solve one quota enforcement problem another is created, such a policy in a pelagic fishery can lead to large-scale dumping which will evoke complaints of wasted protein and also complaints from trawlermen and shellfishermen that their grounds and gear have been irretrievably fouled.

17. DOMESTIC QUOTA ALLOCATION

It will be recalled that, while the primary objective of quota management is seen as ensuring that the national quota is not exceeded, secondary aims exist in respect of market supply and sensible quota utilization. More particularly, it attempts to ensure equitable sharing of fishing opportunities to the appropriate sectors of the domestic fleet. Experience has shown that the achievement of these particular aims can severely complicate the already complex problems surrounding the monitoring of the national allocation, especially when a number of quotas are involved. As will be described it can consume a disproportionate amount of manpower and resources normally assigned to fisheries enforcement and is conducted very largely at the expense of other equally important commitments.

The over-riding problem to be faced is that of formulating a satisfactory base on which to place the allocation. This is because the variability in performance between individual fishing vessels even of the same class is such that it cannot be adequately described by reference to single parameters such as length or tonnage. In reality this catching ability depends upon an amalgram of factors which include the vessel's available power, hold capacity, towing ability, engine power/weight ratio, the overall level of running costs and above all the calibre and expertise of the vessel's skipper. A number of attempts have been made to evolve mathematical models and formulae which seek to take all these relevant points into account and produce a quota coefficient for each vessel which could be applied to the proposed quota. These were originally undertaken in considering the implications of introducing effort control as a measure which would complement quota control. Regrettably, the idea was never fully developed and it has been necessary to depend on less sophisticated means of allocation evolved in consultation with the fishing industry. Seen from the point of view of the Administration, it is immaterial how the quota is shared in principle, but it must weigh carefully the costs which will be incurred by its involvement in what might well be considered to be a purely industrial matter. Ideally, such sharing should be undertaken by the fishing industry itself, but government involvement is often politically difficult to avoid. Indeed, if an Administration decides to involve itself in adjusting the flow of fish to the market place, it must lose any remoteness from the detailed affairs of the industry it may have enjoyed. However, it must be borne in mind that in the long run the enforcement agency must monitor the uptake of each vessel in order to contain the national quota. Experience suggests that it is not normally acceptable to delegate this responsibility to the different sectors of the industry, each of which may suspect the creditability of the others. Inevitably this approach has led to compromise solutions which may be far from ideal, because of the diversity of views among the fish catching interests. For instance, the needs of fish-vessel owning companies are often different from those of the vast majority of boats which are skipper-owned or operated on a traditional share basis. The Administration must balance these views with those of other sectors of the industry, such as buyers and processors who might entertain suspicions that quotas might be manipulated to their disadvantage by the fish-producing side.

18. THE SOUTH-WEST OF ENGLAND MACKEREL FISHERY

The South-west of England Mackerel Fishery serves as a good example against which the problems of domestic quota management can be illustrated. It is chosen because, as a single species fishery operating close inshore, it appears on first acquaintance as possibly the simplest of all cases to control. It is an extremely intensive seasonal fishery involving about 100 freezer trawlers, purse seiners, pelagic pair trawlers and up to a further 200 small hand-line vessels under 40 ft in length. The main effort is directed by sophisticated purse seiners and very effective pair trawlers operating mainly inside the 12-mile limit off the Devon and Cornish coastline stretching along some 300 miles. Vessels over 60 ft in length may not fish for mackerel within three miles of this coastline, since this is reserved for the local inshore line fishermen who object to the exploitation of "their" stocks by British visiting vessels they regard as foreigners. There are three main landing ports through the area. At one of these, namely Falmouth, up to 45 or 50 factory vessels, variously registered in USSR, Poland, GDR, Italy and Egypt, are situated to accept transhipment of mackerel from the catching vessels.

With the exception of the small inshore handliner fleet, all vessels wishing to participate in this fishery must be licensed to fish for mackerel. There is no restriction on the number of licences issued except in regard to freezer trawlers and purse seiners, whose numbers are confined to those which participated in the 1980 fishery, which incidentally may be seen as one of the earliest attempts to

restrict effort in fisheries management. Licences are issued gratis under the enabling powers of the Fish Conservation Act. These provide a flexible means of affecting control over the fishery through conditions which variously carry penalties for infringement, which on summary conviction can range from US$80,000 for fishing, say, inside the 3-mile limit, through to $3,000 for exceeding a weekly quota to US$15,000 for failing to report as required. The licence also serves as a convenient legal means of stopping the fishery at the appropriate time by simply suspending it.

The quota is allocated in two ways. First company-owned freezer trawlers which operate under tightly disciplined internal federation control are granted a Sectoral Quota. This represents a negotiated percentage of the national quota which is based by and large on the past performance of these vessels over past years. It is a very flexible arrangement, which enables this group to fully utilize their fleet cost-effectively and extract the greatest economic benefit from the fishing opportunities afforded. They may take this quota at whatever rate or time in the quota period they prefer, using one or all of their ships to do so as they might find convenient. The administration's task is then simply to ensure that the sectoral quota is not exceeded and, to this end, requires that vessels report their catches weekly by radio and confirm these in writing. These data are verified by rigid checks, which are made on these vessels when they discharge their cargos to shore-side cold stores or refrigerated cargo ships, and they are subject to routine surveillance throughout. When not utilized for fishing, these vessels can operate as receiving ships, although their freezing capacity is rather less adequate than ideal for this role.

All other sectors of the catching fleet are given an equal choice of whatever system of allocation they prefer. Sectoral quotas have been considered by these groups but discarded through lack of mutual agreement on the allocation each should receive. Finally they suggested a weekly vessel quota, ostensibely on crew numbers, which in effect gave quotas of varying sizes to a number of vessel length groups which again differentiate between pursers and trawlers. This was in fact adopted by the government which accepted responsibility for the administration of the system. In the event this proved an extremely expensive exercise and entailed considerable expenditure of enforcement effort before it was finally brought under really effective control. Initially skippers were required to declare details of quantities landed or transhipped by the Friday of the week following that when the discharge occurred. This was seen at first, and in retrospect naively, as the basis for monitoring quota uptake. Skippers were lax in their reporting and chasing them became a tedious and frustrating task, given their mobility. Gross checks of reports with agents' and salesmen ledgers revealed some discrepancies at first but inevitably these checked exactly with vessels weekly allocation. Clearly more draconian enforcement was required.

The fishery has two distinct aspects, each of which create their own problems. The fish is either landed ashore to refrigerated road-transport or transhipped to the aforementioned Klondykers or freezer trawlers. The fishery is operated on a 24-hour basis with a peak occurring between 2200 hours and 0400 hours. Catches might land or tranship up to three times a week and on each occasion might perhaps tranship part of their catch to two or three recovery ships and the final balance ashore. Clearly each of these activities have to be monitored to discover the week's total for each vessel. Spot checks were instituted and, for landings, involved constant surveillance of the discharge operation. Inspection of transhipment was more time consuming and difficult because more of the ships were moored in an exposed anchorage clear of the shore, at the insistence of local complainants about the noise, smell and pollution these vessels are alleged to create. Boarding these vessels was therefore dependent upon the weather. A further but fundamental problem was encountered in that fish was discharged in netting brails, the capacity of which approached a cubic metre or 0.8 tonnes, often only partially filled and only rarely checked and weighed. There were other minor problems too numerous to mention.

In order to overcome the difficulties, the fishery was placed under the supervision of a Control Officer embarked in a Fishery Protection Vessel stationed to seaward of the transhipping anchorage. He had full discretionary powers and the Control Ship provided him with a 24-hour communication and boarding vessel facility. Each catcher was required to seek permission from control to land/tranship a declared quantity and permission could be withheld until the quantity on board had been verified/agreed with the skipper. The carriage of more than the catcher's weekly entitlement was also prohibited.

A number of such measures were employed but all failed ultimately to curtail skippers landing over their weekly quotas and making false declarations. It was an interesting but frustrating situation because, ostensibly, on the basis of the data provided, the fishery was adequately under control. In fact this was far from the case. Fishermen had soon appreciated that, notwithstanding the frequent checks of their catches on board and the uncomfortable accuracy with which these were being assessed, there was no way in which these could be accurately computed. Further, they saw that there would be difficulty in relating the results of any particular check with any made earlier. They were correct, for it was indeed found impossible to build a suitable case for prosecution on the standard of evidence gleaned from these checks. As more and more fishermen appreciated the virtual impotence of the enforcement authorities, the real control over this fishery faltered almost to extinction. A new approach was clearly necessary to restore the situation.

This was made by switching the enforcement effort away from the catches and directing it towards the recovery vessels. These ships were then required to record accurately the quantity of fish received from each catcher under pain of swift prosecution should they fail to do so. The vessels were subject to regular and spasmodic stringent examination by a vigorous specialist team. The results were dramatic, since the fishermen had now lost their own control of the situation and the fishery was brought under very firm control indeed.

While in the event the operation was a qualified success, it is useful to reflect on what might have been done with the benefit of hindsight to avoid the experience endured. It is also interesting to consider how control was lost, given acceptable levels of compliance, when the fishery was first brought under quota control. Then it is worth looking at the costs involved to see if in fact the eventually successful end really justified the very expensive means.

In retrospect, given ideal conditions, the fishery might have been more effectively and quickly controlled if observers had been placed on each recovery vessel, in order to tally and weigh each brail of fish as it came aboard from the catchers. This could have been financed perhaps from licence fees. In fact these procedures would have been impossible at the time because, unfortunately, national legislation made no provision for licensing the recovery vessels or to reserve fees for licences, etc. It is a matter which has of course now been remedied.

As to the reasons why control was lost, these arise from a lack of appreciation of the basic tenet of law enforcement, that reasonable compliance with any law must depend upon the tendency of most people to wish to obey the law, knowing that, if caught not doing so, they would expect to be punished. Essential to this philosophy is a belief that the law is reasonable and just. In the case illustrated here the justness of the piece was brought into doubt when prosecutions were brought, "pour encourager les autres", on the basis of declarations over quota. In other words, fishermen were prosecuted for telling the truth. Declarations soon showed exactly the quota amount, as did the salesmen's ledgers with which they were checked. The reasonableness of the situation was questioned when a combination of vessel quota allocations were reduced and market prices fell to a level where the economic returns to vessels failed to meet their costs. Further, fishermen saw that even blatent transgressions of the controls, particularly in respect of foreign landings, were not being apprehended. They reasoned that "what was sauce for the goose was sauce for the gander" and soon embarked on a slippery slope of compounding falsehood upon falsehood. It was a trend which could only be stopped by urgent and positive action and, strangely, was very strongly welcomed by the fishermen when eventually applied.

The costs of such a control is very high indeed. It can exceed 25 percent of the first-hand sale value of the total weight landed, and it is not unknown for up to 80 percent of available resources to be directed towards quota-management contingencies. Notwithstanding the other problems involved, such costs must be a major consideration in assessing the viability of quotas as an effective conservation tool.

19. CONCLUSIONS

In essence, quota management is an exercise in data acquisition. It depends on reliable information about what quantities of quota fish is caught where. Considerable problems are inherent in this requirement and these lend force to arguments that quotas are in fact unenforceable. Certainly they are extremely costly in manpower and resource but, requirements in the event, can be enforced to some degree, dependent upon circumstances.

PRACTICES AND PROBLEMS WITH LICENCE LIMITATION IN THE USA AND CANADA

by

R. Bruce Rettig
Department of Agricultural and Resource Economics
Oregon State University
Corvallis, Oregon 97331
USA

INTRODUCTION

Although programmes to limit the number of participants in specific fisheries in the United States and Canada have precedents dating far back in time, most activities have occurred during the last fifteen years. An ordinance restricting the number of vessels harvesting oysters in one area in New York State was passed in 1679. Another early example (1889) is the limitation to the number of fishing boats to be used on the Fraser River in British Columbia, Canada. That these and other examples were uncovered by scholarly research supports the view that licence-control programmes tended to be relatively localized and/or of quite short duration until recently. Current licence limitation programmes in Canada began with the lobster fishery in Atlantic Canada (1967) and the salmon fishery in British Columbia (1968), with coverage extending to other fisheries in the 1970s. Some programmes in the United States began in 1968 (e.g. Michigan and Wisconsin), with programmes to freeze the total number of fishing licences in several important Pacific and New England fisheries coming into effect in the early 1970s.

As the concept of licence limitation became increasingly familiar and as licence control programmes were more widely considered, interest grew in the strengths and weaknesses of the earlier programmes. Public officials drew on prior experience, hoping to avoid mistakes made in other geographical areas as well as to correct errors which they or their predecessors might have made. Both proponents and opponents in the fishing industry drew on information about earlier experiences to document their own point of view.

The advent of extended fishery jurisdiction led both the United States and Canada to re-examine the possibility of using licence limitation and other market-related regulations. To enhance these discussions, a series of meetings were held in 1978. A small group of technical experts met in May in Washington State to define possible weaknesses in the use of licence limitation, taxes and individual fisherman quotas. Two months later, a large conference was held in Denver, Colorado to share critical concerns about such approaches among technical experts, public officials and members of the fishing industry. The next month a small group of technical experts met on the British Columbia coast to further explore possible weaknesses of limited entry, with a critical focus on finding ways to improve the effectiveness of Canadian management programmes. The United States meetings resulted in the volume edited by Rettig and Ginter (1980), while selected papers from the Canadian meeting were published as a special issue of the "Journal of the Fisheries Research Board of Canada" (Pearse, 1979).

Although all 1978 meetings were effective in sharing information on limited entry programmes in the United States, Canada and a few other countries and in identifying points of concern, none led directly to revised programmes. Subsequent discussions have taken different directions in the United States and Canada, associated with different fishery management institutions in the two countries. In Canada, commissions of enquiry have been formed for the Pacific and Atlantic coasts, to develop concrete suggestions for changes in fishery policy. The Pacific commission has filed its final report (Pearse, 1982) and the final report of the Atlantic commission is expected in the near future. In the United States, where decisions on the use of limited entry must be initiated at either state or regional levels (by law the national government is barred from such initiatives), important discussions have taken place on new approaches. For example, in Alaska, adoption of an individual shares programme for the valuable Pacific halibut fishery is being discussed, while California, Oregon and Washington fishermen have been attempting to identify consequences of limited entry in multi-purpose and multi-species fishing fleets (a problem stressed by New England fishermen at the 1978 conference).

The purpose of this paper is to paint a broad picture of the various programmes which have been discussed at the meetings described above. First, some of the points of general agreement will be summarized. Next, several important experiences with licence limitation will be summarized, with the general focus being the scope of those experiences, the reasons for the variation in approaches and a general evaluation. Finally, the paper will conclude with a discussion of trends which appear to be emerging from recent changes in limited entry programmes and some thoughts about what forces are likely to lead to still further changes.

Why limit licences?

One important reason why licence limitation has been more widely adopted than some other forms of limited entry is that it is relatively familiar and understandable. Fishery management has, in common with other forms of public policy, a tendency to evolve under incremental changes. Commercial fishermen do not like to purchase licences but they recognize this as an event which is required from State to State (or province to province) and which has been going on for some time. Indeed, the fewer the new restrictions imposed, the more familiar the criteria for licence eligibility and the more the licence-control programme resembles other programmes familiar to the fishermen, the greater will be the political and administrative feasibility of the programme.

Another, related reason for licence limitation is the line of reasoning which often motivates its adoption. The initial discussions begin with a wide agreement that either "there are too many of us fishermen" or that "there are not too many of us now but we believe that several newcomers plan to enter our fishery and then there will certainly be too many fishermen." To alleviate or mitigate this concern, participation is temporarily limited to those who have participated in the past or who have already made major financial sacrifices to enter. These moritoria are often renewed once or twice before participants decide that the cause for their concern will not soon disappear. The final step is a conversion of the moritorium to a permanent licence-limitation programme.

Although the common reason for adoption of entry control is a consensus that the number of participants has become too large and threatens to become even larger, the specific programme under discussion and the processes required to develop and implement the programme will lead to a wide variety of objectives. Further, the events which lead to an excessive number of fishermen are quite varied and, due to a diverse set of perceptions by those actively involved, will also lead to a variety of statements of objectives. Since there are so many objectives and the relative importance of the various objectives depends on the perception of those assessing the programme, the objectives are not discussed here but are highlighted in Appendix A.

Which fisheries tend to employ direct controls?

Use of direct controls, whether one is considering licence limitation or a number of other regulations which are sometimes called traditional fishery management measures, is importantly influenced by the stochastic nature of fisheries. Indirect controls often work with a substantial time lag between changes in the regulation and the consequences of such changes. Long delays are unacceptable when fishery management agencies learn that environmental variations, such as a change in timing or intensity of upwelling, have changed the availability and/or abundance of the fish, in turn making an important stock vulnerable to unexpected overfishing. Management of many important fisheries requires the ability to make changes rapidly, especially area closures and gear restrictions.

Pacific salmon and herring fisheries are good examples of the use of direct controls for valuable, highly variable fish populations. The proportion of salmon stocks which survive to the harvestable stage depends critically on environmental conditions in the freshwater and marine stages of their life history. While research into the several salmon species and monitoring of environmental conditions permit management agencies to establish certain regulations in late winter and early spring, which govern seasons through summer and into the fall, any experienced agency biologist will unhappily provide numerous examples of errors leading to serious under-escapement of adult spawners back to hatcheries and natural spawning grounds. Emergency closures of seasons are all to common in salmon fisheries. Consequently, it is not surprising that licence limitation programmes in salmon have garnered more support following years in which environmental "surprises" lead to shortened seasons.

Rapid changes in direct controls are used less in fisheries in which either fish are long-lived and reproduction can be based on several year classes (e.g. Pacific halibut) or in which fishing methods do not tend to threaten the viability of the resource (e.g. Dungeness crab). In the first case, regulations are designed to meet general harvest goals. If over-harvest occurs in one time period, a smaller catch can be allowed in the next time period. In the second case, requirements that sufficient crab of smaller size escape the gear and the ability of the smaller animals to fully serve reproductive needs of the next crab generation reduce the need for in-season changes.

The two examples just given were carefully chosen to illustrate the interest in limited entry even where direct controls are less important. The price of halibut has become so high relative to harvesting costs that an overall catch quota, in combination with uncontrolled entry, has reduced the length of operating season to a few days. Additional costs have been placed on fish processing and there has been a decline in product quality to the ultimate consumer. In the second case, long-term cycles in abundance of Dungeness crab populations lead to expansion in capacity during the up-years of the cycle and significant economic dislocation in down-years. Although many crab fishermen accepted these consequences of the cycle when other valuable fisheries were available for multi-purpose operations during the down-years, increased pressure on alternative fisheries may be changing those views. If such alternate fisheries as Pacific halibut, salmon, groundfish and shrimp all had limited entry programmes, crabbers would be more inclined to support limited entry as a defensive measure.

Relationship between licence limitation and taxes

Commercial fishermen in the United States and Canada pay a wide variety of taxes to local, regional and national governments. Some of these taxes are based on total income earned from fishing plus other sources; some are based on the value of vessel and other real property; some are proportional to the volume of the particular species landed; and there are several other classifications of taxes as well. None of these measures appears to be directly proportional to fishing effort (which is one limited entry proposal) but several are poundage taxes (which has been another proposal to influence fishing effort).

While taxes are widely levied, there are a number of reasons why they cannot be effectively used to address concerns which often trigger requests for limited-entry programmes. The political process through which taxes are altered works very slowly. Tax changes are based on the need for additional revenue by the relevant level of government and have little to do with the number of vessels and fishermen in a particular fishery. Even if taxes could be changed quickly, politicians are more sympathetic to tax increases when landings are high and less receptive when landings are low. Thus, taxes are most feasible when restrictions are not needed and least feasible when restrictions are needed due to natural variability. Even if political arrangements did allow taxes to be adjusted quickly, there are several reasons why taxes are not likely to be effective. When valuable species are scarce, processors will have an incentive to follow approaches such as classifying a heavily taxed species as some other species on the landing receipt. Even if the taxes were effectively enforced, economic studies of fishermen behaviour suggest that their short-run decisions about allocation of fishing effort among various species are not highly responsive to price changes and, hence, many fishermen are unlikely to be responsive to modest changes in tax rates on landings. This long list of "even if" statements strongly suggests that taxes are not likely to be used for short-run regulation of fishing effort.

Rather than serving as a critical tool for fine-tuning effort levels, to meet needs associated with fluctuating biological populations, taxes should be reserved for two alternative but important purposes. First, if other measures such as licence limitation or individual fisherman's quotas were extremely successful in raising income levels of the remaining fishermen, a portion of those increased revenues could be collected as "royalties." Second, taxes could be set as a long-term limited entry instrument in fisheries in which such factors as extremely high resource value create chronic conditions of excess capacity. Tax measures are likely to be highly unpopular among fishermen unless revenues collected are directly dedicated to research and actions taken to enhance the biological populations being harvested.

Relationship between licence limitation and traditional fishery management

Fishery managers use a "diversified portfolio" of policy instruments including quotas, time and area closures, gear restrictions (such as net mesh size), size limits, limits on the number and/or timing of trips and restrictions on the size of catch by species per trip. In the United States and Canada, these traditional fishery management tools are used to avoid biological over-fishing. Over-fishing, in this context, refers both to impairment of a biological population's potential to fully reproduce itself and to the harvest of a stock at an age where the growth rate significantly exceeds the natural mortality rate. A broad consensus exists within the United States that licence limitation, by itself, is not effective at preventing biological over-fishing and that traditional fishery management measures are often capable of handling these resource-conservation needs without the use of licence limitation.

Traditional fishery management cannot be developed to meet the traditional objective of resource conservation independently from limited entry considerations. Over-capitalization of commercial fisheries often impairs the ability of management agencies to use these regulations as effectively as when the resource was lightly exploited. Although this issue will be thoroughly developed in other background papers, an example may clarify the argument. Seasonal closures are traditionally used to protect fish in certain critical life stages, as when crabs are soft-shelled, and to encourage harvest of fish at larger sizes and/or more desirable quality to the consumer. When seasons are substantially shortened, as a device to allocate the allowable harvest among an excessive number of fishermen, some sub-populations are over-harvested. An associated, but slightly different, concern arises when traditional fishery management measures are used to allocate allowable catch among competing fishermen. These measures are sometimes enforced using data provided by fishermen. Data which, at one time, was very valuable in analysing biological populations then either becomes unavailable or unreliable.

An important reservation needs to be added to the argument that licence limitation enhances the ability of fishery managers to achieve conservation objectives with their traditional means. Licence control programmes do not always lead to planned outcomes. For example, moritoria often increase the number of effectively participating fishermen. Managers then have to deal not only with problems based on fishermen's behaviour in the past but also speculative behaviour arising from the desire to qualify for future changes in the licence programme.

Relationship between licence limitation and private social institutions

In the United States and Canada, fishermen's decisions concerning amount of fishing effort and its distribution over time and space are not simple profit-maximizing choices in a perfectly competitive economy. Rather, many social arrangements apply, some enforced by public law and some enforced through informal social groups such as family, religious institutions and friends. Stories abound about informal understandings that "this is where I fish" and strangers trying to move in may face real or potential violence from the long-time fisherman and his friends.

Several private institutions restrict fishing effort at times when the need is not indicated by resource management criteria. For example, when a fluctuating resource has been particularly abundant, fishermen have gone on strike to negotiate higher prices. Also in years of unexpected abundance, markets for one or more species have been glutted, leading processors to buy only from fishermen who have supplied them in the past. Even those fishermen who secure purchasing outlets may find themselves "on limits" (only a limited number of purchases to be carried out or a limitation on numbers of fish to be accepted at any sale). Just as "output" markets restrict effort at the wrong time, so do "input" markets. A limited number of berths in boat basins, limited gear supplies, etc. occur most frequently when fish are unusually abundant.

While many private arrangements have their impact when they are not needed for management purposes, some counter examples do exist and merit careful consideration. Informal property rights have already been mentioned. Another example is limited information: many fishermen form code groups to tell other members of their group where fishing is good and which areas to avoid. These arrangements increase in importance when fishing is poor. Newcomers find easier access to good information when fish are so abundant that the experienced fishermen do not feel threatened by the newcomers.

Licence limitation is cheaper and finds greater acceptability when it conforms to private social arrangements rather than defying them. This will be illustrated later in this paper when programmes on the Pacific coast are described which include special licence provisions for native Americans. Although this argument has been made in terms of licence limitation, the same principle holds for other forms of limited entry. Rather than developing individual fishermen's quotas which require national or regional decisions on the distribution of individual rights, in some cases group quotas can be defined with a family, ethnic group, cooperative, corporation or other organization dealing rapidly with concerns which are most difficult at the national level.

What are the major criticisms of licence limitation in the United States and Canada

Foremost among concerns about licence limitation voiced by economists is that such programmes tend not to improve economic efficiency as compared to open access conditions. If vessel-licence limitation combined with a fleet reduction programme increases profitability, remaining vessel owners will try to increase their share of the resource by further investment, such as in larger vessel size or additional gear. If licences are tied to fishermen rather than vessels, the same phenomenon will occur - investment will tend to increase the effective fishing power of each remaining fisherman. Thus "capital stuffing" (the tendency to increase the ratio of capital expenditures to whatever component of effort is limited), "seepage" (the tendency for effective fishing effort to seep back when nominal effort is reduced) and similar terms reflect the theoretical economist's argument: if there are n (3 or more) inputs to a productive process, one of which is unpriced (the fish in the sea) and another which is reduced, while the value of the product is constant or continues to rise, then profit-maximizing firms will tend to increase their use of one or more of the other inputs.

The tendency for economic-efficiency gains from licence limitation to be dissipated over time has been recognized by managers of licence control programmes in North America. As British Columbia authorities noted the tendency for the restricted number of vessels in salmon fishing to be replaced by larger vessels, restrictions were added requiring ton-for-ton replacement, i.e., to add a new vessel twice as large as older vessels, two vessels would have to be retired rather than just one. Additional restrictions limited the ability of vessel licences to be transferred from one gear type to a different gear type having greater fishing power per unit of size. The economist-critics agree that changes in rules can offset tendencies to stuff additional capital into a fishery but they still claim losses in economic efficiency associated with the costs to both industry and management as each tries to outguess and keep ahead of the other.

Economic-efficiency gains need not be lost through the processes just described. Where technology is relatively inflexible, there may be few opportunities to invest additional capital in certain vessel types. Even if new technology is embodied in greater investment, it may take place so slowly that new management rules can easily offset its impact with little loss. Also, the short-run gains may justify programme adoption even if seepage is complete in the long-run. Several other forces can also retard investment thought not to be in the larger group's interest. These factors include social sanctions imposed by the group, existence of formal or informal property rights, tax laws which discourage investment (note that accelerated depreciation tax treatment and public loan/subsidy programmes, on the other hand, tend to more quickly eliminate economic gains to the group) and incomplete information about investment opportunities. However, the more rapidly the value of the fishery rises over time and the greater the opportunity to increase fishing power per dollar invested, the weaker are the forces just described.

Licence-limitation programmes which affect economic efficiency also affect the distribution of wealth. The possibility that the income distribution will become more skewed is of slight concern; of greater concern is that a few become wealthier because of a government programme. That is, many fishermen will accept unequal wealth based on differences in skill or information, gained through experience and willingness to accept great risk, but will find it more difficult to accept those same inequalities when conferred by an act of law. The qualification for licences being associated with historical landings records, therefore, responds to two important considerations - to mitigate income losses by those who are kept out of the fishery and to award income gains in proportion to criteria acceptable to fishermen. Nevertheless, equity considerations are usually the most difficult for programme designers to address and are the grounds on which programmes will be most critically judged by the public.

Even greater than the concern for distribution among a group of fishermen are the feelings by United States and Canadian fishermen about the impact of licence-limitation programmes in allocating fishing access among groups. Group classifications which have been associated with the greatest amount of public discussion relate to geography, gear type, ethnic heritage and reason for harvest (recreation, commercial sale or subsistence). Beyond the desire by each group to defend its interest relative to another group's interest, there are important social concerns that are impinged upon by licence limitation. The Alaska legislature attempts to protect the interests of Alaskan fishermen, relative to fishermen from other States, in part because of concern for high unemployment in coastal fishing communities. The relative amount of salmon fishing effort allocated between trollers and net fishermen will influence the proportion of fish which will go into canned relative to fresh fish markets. Commitments to native American populations (American Indian) and Eskimos lead to differential access requirements in both Canada and the United States, which appear to be approved by the national population but are deeply resented by local non-Indian fishermen. Consideration of these diverse social objectives, as important as they are, create great difficulties for designers of licence limitation programmes.

In summary, the "softer" the licence limitation programme, the less likely it is to create economic-efficiency gains, while the "harder" the programme, the more likely it is to create administrative and political difficulties, especially due to concern for equity. These are the sort of issues which Clem Tillion can be expected to address articulately. The arguments made in this section, some of which will be discussed by Tillion, as well as additional ones which were raised at the 1978 United States conference on limited entry, are capsulated in Appendix B.

LICENCE LIMITATION IN THE UNITED STATES AND CANADA

British Columbia

The licence limitation programme for salmon in British Columbia has been widely discussed because it was the first such action in North America to substantially alter a large, highly valuable fishery covering a wide geographical area and diverse gear groups. Canadians had tried many approaches to deal with overfishing problems in this fishery, including two early attempts at limited entry, one from 1889 to 1892 and one from 1908 to 1917. The current programme was announced in 1968 and initiated in 1969 following more than a decade of analysis and discussion among academicians, government officials and the fishing industry.

The initial public announcement of the limited entry programme emphasized two objectives - to increase the earning power of fishermen and to permit more effective management. However, each of these objectives was actually more complex. Underlying the first objective was a goal of effecting socio-economic rationalization of a fleet which was believed to have become far too large, while "more effective management" reflected a desire to improve the capacity of traditional fishery management tools to achieve resource conservation goals. Although equity considerations and administrative feasibility were not comparably discussed, both the choice of management measures and the process by which they were introduced imply careful consideration of these objectives.

The programme, as initially announced, had four parts which were to be phased in over several years. Fleet size was to be immediately frozen, followed by fleet reduction, an improvement in vessel standards and product quality, and, finally, introduction of optimal gear and area regulations. As time went by, some measures were deferred or introduced in a weakened form while other measures were added which had not been part of the original programme design. Critics tend to consider these changes a desertion of responsibility and reaction to special interest groups while supporters applaud the adaptive process by which policy is revised in response to new information.

Experience with licence control in the British Columbia salmon fishery suggests that among the most important questions are: Who qualifies initially? How is qualification maintained? Are licences transferable and, if so, how? Other than receiving a transferred licence, are there ways to enter the fishery? How much is the licence fee? Are licences simply frozen or are there either fleet-reduction or controlled fleet-growth programmes? Does the licence apply to one species, all fish or some defined group of species? What geographical area does the licence cover? Is the licence specialized to specific gear types? Some of the programme elements have already been described. A few more will be touched on in a brief summary evaluation of the programme and others will be discussed when other programmes are covered below.

Did the programme make the fishery more efficient in an economic sense? Those who have assessed the programme are deeply divided. Critics have made a clear case that, while the number of licensed vessels has declined by over one-fifth, the capacity of the fleet has grown substantially along with capital investment. This has happened through the replacement of old vessels with newer, larger, more technically efficient vessels and by the addition of new technology embodied in the gear deployed. One of the counter-arguments is that much of the reason that capacity has grown in the last fifteen years is that salmon prices have risen sharply and that without licence limitation an even larger amount of investment would have taken place. Evidence for this argument includes the growth in the Pacific halibut fishery where licences were not limited until 1979. A second counter-argument is that the new vessels are both safer and more comfortable and these outcomes should be counted as benefits rather than costs.

Public revenues have gone up. Indian licences, and non-Indian licences which are tied to low-production vessels and are slated to expire in 1983, are $20 per year. License fees for non-Indian, high-production vessels range from $200 to $800, depending upon length and weight of the vessels. Here, critics would argue that this rise in revenue collected is small both in absolute amount and relative to the increase in public expenditure on salmon research, management and protection of the resource.

Has the programme been administratively effective and politically responsive? Here, also, one's answer depends upon one's perspective. The frequent changes in the programme and numerous studies of the programme can suggest either that the decision-making authority concentrated in the office of the Canadian Minister of Fisheries is exceptionally responsive or that a series of bad decisions were made and had to be corrected.

As already mentioned, original plans were to reduce the capacity of the fishing fleet. One way to achieve this was to limit ordinary licences to harvesters with a significant involvement in the salmon fishery and to phase small producers out during the next ten years. Adjustment of qualification rules to give licences to fishermen without recent salmon landing history was certainly responsive and probably equitable, but it also made fleet reduction more difficult. The fleet reduction (buyback) programme was never funded at a significant level and was plagued with problems. Finally, while the plans were to increase licence fees modestly at the outset and increase them sharply at a later date, increases never did rise to a level which observers judged to be very high. All of these variations from original plans were politically responsive but worked against the capacity-reduction objective.

Has the programme been responsive to equity considerations? While the answer certainly depends upon one's perspective, several programme elements and adjustments over time indicate high sensitivity to equity concerns. For example, initial eligibility for a regular licence (transferable and indefinite in tenure) was proof of a record of significant involvement in commercial salmon fishing, while eligibility for a temporary licence (renewable up to ten years only - later extended five more years) was based on a history of smaller harvest levels. Restriction on the number of licences to be held by processing companies was added in response to fishermen's arguments that concentration of many licences in the hands of a few would not be fair to the bulk of the fishermen. Although economists made a case for transferability of licences on economic-efficiency grounds, this licence feature was even more strongly supported by the equity argument that a salmon fisherman who labours long and hard deserves to pass that privilege to other members of his family or to benefit through sale of the licence.

The part of the licence programme designed on equity grounds which has probably most perplexed government officials has related to Indians, especially those in isolated fishing communities. During 1969 and 1970, Indians were treated just as non-Indians, except that the Department of Indian and Northern Affairs worked actively to support new entrants and to keep eligible Indians in the ordinary ("A" licence) programme rather than the temporary ("B" licence) programme. In 1971, a new licence (A1) was created for Indians which combined the features of low licence fees and indefinite tenure. These new licences were freely transferable to other Indians but could only be transferred to non-Indians by paying the accumulated difference between actual payments for the A1 licence and payments which would have taken place had the licence been an A licence. In 1972 all temporary (B) licenses held by Indians were reclassified as A1. Following a steady decline in numbers of Indian fishermen, holders of Indian licences were no longer permitted to convert them to ordinary licences beginning in 1980. In summary, several measures in the licence control programme were taken in concert with other actions by the Canadian government to address equity concerns for the aboriginal population.

Has the licence limitation programme enhanced the ability of management to promote resource conservation? While there is disagreement over the relative role of licence limitation among the various factors influencing resource conservation, there is disappointment that the proposed Phase IV (more optimal gear and area regulations) never did appear within the total licence-control programme. Current vessels are more mobile, flexible and efficient than was the 1968 fleet. Consequently, more regulations rather than fewer are required to ensure adequate spawning escapement. However, other factors might well have made circumstances as difficult, if not more so, if licence limitation had not taken place.

Several other fisheries in British Columbia also have licence-limitation programmes. These will not be reviewed here other than to point out that they have arisen for a wide variety of reasons, have had highly varied objectives and have met with different rates of success. The roe-herring fishery effectively began in 1972, after herring stocks had partially recovered from a collapse and international markets became accessible to Canadians (Pearse, 1982). In this case, licence limitation was used in 1974 to gain control over an industry which was growing at a phenomenal rate. Licence fees were rather high ($2,000 for a seine licence, $200 for a gill-net licence and $10 to Indians for either gear-type). The licences were assigned to individuals rather than vessels. Licences were initially non-transferable; later exceptions were made for spouse or next of kin; still later ways were found to make subtle transfers through leasing arrangements. Since the licence control programme had only a limited impact on growth of effective fishing effort, it also had a limited influence on a fishery where resource-conservation goals were very difficult to achieve.

Atlantic Canada

Many fisheries in the eastern provinces of Canada have limited-entry programmes. Although licence limitation was applied to the nearshore lobster fishery in 1967, most of the current programmes were initiated in the early 1970s. The programmes have become fairly complex, apparently to the dissatisfaction of both fishermen and the government (Canadian Department of Fisheries and Oceans, 1981).

Broadly speaking, the goals of the Atlantic licence limitations were the same as those for the Pacific. However, two important factors significantly limited the ability of the Canadian government to press either quickly or far in controlling fishermen and vessel numbers. First, not only are Canada's Atlantic fisheries economically depressed, but much of that part of Canada experiences chronically high unemployment. Most of the fishermen engage in other activities and use fishing as a part-time occupation. Consequently, any programme which would greatly reduce employment in any fishing activity meets significant opposition. Second, Canadians harvested a modest share of valuable fish populations in very productive waters over which they claimed exclusive control only in 1977. In those fisheries, allocation of access among domestic fishermen was not considered to be appropriate until the international access issues were resolved. Similar problems delayed or complicated discussion of licence control over certain resources in British Columbia, but in Atlantic Canada sensitivities appear to have run even higher. That this special factor appears to be related to historic management of the Grand and Georges Banks is supported by the parallel experiences of New England fishermen in the United States.

Summary statements by groups currently examining Atlantic Canada licence limitation imply that these programmes appear to be harshly judged using economic efficiency, administrative feasibility, equity and resource-conservation criteria. Why this may be the case will be explored by others at this Consultation. In any event, there appear to be tendencies to decentralize decision-making with respect to licence control and to consider novel approaches such as individual fisherman's quotas.

Alaska

Objectives for Alaska's license limitation programme for salmon can be stated simply as: to raise income levels of native Alaskan fishermen and to increase the ability of management agencies to address conservation needs. As was true for British Columbia, however, the development and administration of the current programme reflect a much wider array of goals, which are the product of a century's struggle to manage a valuable resource and of consideration of the special needs of the people affected. Alaskans have long resented dictation of their fate by a government headquartered

far away on the other side of the North American continent. Alaskan fishermen have also resented their dominance by a canning industry which, for many years, was centred far to the south in Seattle, Washington. Finally, resident fishermen mistrust and often resent foreign fishermen, including both fishermen from other Nations intercepting salmon on the high seas and fishermen from other States.

The struggle to improve the share of salmon harvested by native Alaskans was a key part of the 1956 constitution when Alaska became a state. It also led to two attempts (1962, 1968) to pass limited-entry laws giving preference to local fishermen. Both of these attempts to discriminate against non-Alaskan United States citizens were overturned by federal courts. Having been frustrated many times prior to statehood and twice since, a study group carefully prepared legislation in 1972 which addressed a wide variety of social, economic and conservation objectives for a complex limited-entry programme.

In contrast to the tendency in most programmes to qualify virtually anyone with a history of salmon fishing, the Alaskans carefully defined eligibility rules to force out a number of fishermen. Not only was limited entry to reduce the size of the heavily over-capitalized fleet but those remaining were to result in improved management and a more professional fishery. Eligibility for a licence was based upon the degree of economic dependence upon the fishery and the extent of past participation in it.

While Alaskans chose not to state an overall concept of economic efficiency, rather identifying a number of broadly stated economic and social goals, they were nevertheless committed to avoiding the "capital stuffing" which they observed in British Columbia. To deal with the shifting of vessels into processing-company ownership, with the replacement of vessels using one gear type by vessels with more powerful gear types and the shifting of vessels from one area to another, licences were assigned to fishermen rather than vessels and were specific to a particular gear type and area. Although any fisherman could not have more than one licence in each category, he could own single licences in more than one category. For example, he could not own two Cook Inlet purse-seine licences and a Chignik purse-seine licence. This level of detail in licensing did increase the control of licences but it also increased the cost of initially awarding licences and monitoring the number of licences over time.

Licences are transferable, although this characteristic has been reviewed and does find opposition. One of the concerns, that transferability would lead to a shift of ownership away from Alaskans, seems to be unfounded. Of the entry permits transferred between 1975 and 1978, 58 percent were transactions between residents, 20 percent were transactions between non-residents, 14 percent were transfers from non-residents to residents and 7 percent were transfers from residents to non-residents. The average price paid in these transactions generally rose over that time and varied widely by gear type and area.

Annual fees charged for interim-use or entry permits also are more complex than in other areas using licence limitation. Annual fees at the outset varied by type of gear used from $10 to $100. In 1978, differentiation was added with respect to residency - residents' fee schedules ranged from $20 to $200 and non-residents' fees from $60 to $600. For the calendar year 1978, the average permit fee was $70 for residents, $289 for non-residents and $15 for those persons who qualified for a special poverty permit (Morehouse and Rogers, 1980).

Evaluation of Alaska's salmon licence limitation programme in terms of economic efficiency is difficult, both because that criterion was never specifically addressed and because the last decade has seen several forces strongly altering circumstances in all Alaskan fisheries. Selected evidence does suggest that some economic gains have been achieved. First, the substantial prices new entrants pay to purchase permits is consistent with the existence of an economic rent to licence control. For example, licences in Southeast Alaska in 1978 transferred at prices ranging from $600 to $50,000 depending upon gear type; in Bristol Bay prices paid for drift-gillnet licences that same year ranged from $1,000 to $60,000. These prices do reflect phenomena beyond just current net income of vessels in limited fisheries. However, reports that vessel owners with valid entry permits find it easier to borrow money from banks support the view that licence values embody capitalized future rents from access to a limited fishery. These high values are perhaps somewhat surprising in that buyback programmes have not been seriously undertaken and, hence, capacity in 1978 was still excessive. Most recently, salmon returns have been phenomenally large and consumer demand for canned salmon has been temporarily depressed. However, the long-term outlook for the Alaska salmon fishery still appears to be quite good.

Given the great attention to equity considerations, it is not greatly surprising that the programme has been quite effective in meeting its creators' goals. Bargaining power appears to have shifted away from processing companies and toward fishermen, although the relationships between these parties continue to be of great concern to the State Government. The fishermen who qualified initially for entry and those who have since entered are more diversified and tend to include a larger fraction of full-time fishermen, even though the discrimination against part-time fishermen desired by some early limited-entry advocates was not explicitly included in the law passed. The tendency for licences to be transferred toward individuals with higher incomes and the difficulty of entrance by low-income fishermen is a common theme expressed by critics. Associated with this shift, there is also a tendency for the number of permits held by rural residents to decline as permits tend to move both from non-residents and rural residents to fishermen living in the more populous Alaskan communities (Morehouse and Rogers, 1980). This outcome is viewed with alarm by some and as a natural outgrowth of the professionalization of the fishery by others.

While the influence of licence limitation is hard to separate from many other changes which have influenced fishery management in the last decade, licence control appears to support the effectiveness of measures used to ensure resource conservation. Salmon management is based upon forecasts of the size of stocks returning to specific river systems and calculations of spawning escapements for each river or stream. Allowable harvest by area for specific time intervals is based upon the difference between these two estimates. Rapid, unplanned growth in fishing effort by a gear type at any time or place could add uncertainty to management decisions already plagued by large variations originating in the natural environment.

Many of the measures taken in Alaska would not be politically feasible in other parts of the United States. Among the reasons why they were feasible in Alaska are: failure of early attempts at limited entry, which provided a realization that careful construction of legislation and a broad base of administrative expertise would be needed; pronounced, documented trends of the increase in gear, accompanied by decline in returns and a general sense of crisis among fishermen; the commercial fishery's role as a dominant industry; a State legislature with many members knowledgeable about fisheries and even more members concerned about fisheries; interest and expert support from a variety of agencies and individuals; and concerned, active involvement by Alaskan fishermen (Adasiak, 1980: 273-274).

While most of the discussion concerning Alaskan limited entry has focused on salmon, several valuable herring fisheries have been placed under licence limitation and the highly valuable Pacific halibut fishery is being considered for some possibly innovative form of limited entry. As was the case with British Columbia, the interest in limited entry for herring grew most strongly out of the resource conservation needs of a resource which is valued for its roe and which tightly congregates at spawning time. Resource managers argue that no harvest should be permitted without some form of access control due to the extreme vulnerability of the fish populations. As was also the case in British Columbia, Alaskans have long been interested in limited entry for Pacific halibut but were not willing to act until agreement had been reached concerning the international division of the resource. Thorny problems relating to the initial allocation of resource rights, no matter what form of limited entry is adopted, feature discussions of the needs of large versus small vessels, native Alaskans versus fishermen based in the "lower 48" and recent entrants versus fishermen with long-term involvement.

Washington, Oregon and California

While licence limitation programmes now in effect on the Pacific coast of the United States date back to the beginning of this century, they have become a predominant feature of fishery management in major fisheries only during the last decade. The State of Washington has long controlled access to fisheries for oyster and subtidal hardshell clams. In 1967, limited entry was extended to geoduck clams. Herring limited-entry programmes were approved in Washington in 1973 and in California in 1974. California also limited entry to the abalone fishery in 1976. Nevertheless, the public awareness of limited entry in all three States grew out of moritoria on participation in commercial salmon fisheries established in Washington in 1974, followed by somewhat similar provisions in Oregon and California in the same year.

As was the case with Alaska and British Columbia, salmon fishery over-capitalization in Washington has existed for a long time. A limited entry measure which was passed through the initiative process in 1934 was found to be unconstitutional by the State Supreme Court. The Washington Department of Fisheries consistently worked for a licence moritorium in every session of the state legislature, beginning in 1965, and began to receive significant industry support in 1971 (Mundt, 1975: 18). However, a major reason for enactment of a licence moritorium in 1974 was the first of a series of federal court decisions which were to allocate salmon resources from non-Indians to Indians and turn a rather over-capitalized fishery into the crisis environment in which it remains today.

In 1853, the first governor of the State of Washington negotiated eight treaties with Indian tribes of western Washington. Provisions in those treaties which reserved their ancestral fishing rights have been hotly contested ever since. Following a decade of rising violence, the United States filed suit against the State of Washington in 1970. The decision rendered in 1974 by Judge George Boldt and upheld in 1979 by the United States Supreme Court required local authorities to take substantive action to increase the fishing opportunities of the treaty Indians. Subsequent regulations, associated with a number of other events, caused economic dislocation of many non-Indian fishermen. The temporary moritorium measure enacted in 1974 has since been replaced by a permanent limited-entry law. Several attempts at buy-back programmes have had mixed success because of the modest level of funds provided to date by the federal government and the unwillingness in Washington to raise buy-back funds through significantly increasing taxes on economically stressed fishing fleets.

Washington salmon fishermen facing shortened seasons and other increases in regulations shifted southward toward Oregon and California. This took place at a time that both of those States were themselves dealing with over-capitalization, a decline in the availability in certain fish stocks due to environmental factors and growing pressures to accommodate Indian fishermen on the Columbia and Klamath-Trinity river systems. Although initial pressure for licence limitation in California was brought to bear by threat of a federal licensing scheme, adoption of moritoria in both Oregon and California in 1979 was largely due to growing concerns on the part of fishermen.

There are a number of interesting similarities and differences in the laws among the three States. Both Washington and Oregon limited the number of vessels, while California limited people engaged in the commercial ocean salmon fishery. All three States based initial qualifications on very permissive standards. Basically, one was "in" if one landed one (two in Washington) salmon in any of five (six in California) base years prior to the programme or owned a boat under construction during part of the base period or made a good-faith purchase of a vessel intended for salmon fishing. California also included cooperation in landing one salmon as another criterion. Not surprisingly, the number of licensed fishermen rose in the first year of the programme. Licences in Washington and Oregon are transferable while the initial California legislation did not permit transfers, other than for a 15-day emergency substitution. Provisions to reduce the size of fleet consisted of natural attrition associated with non-transferability in California and loss of licence, if continuing landings are not made, in Oregon and Washington. Perhaps of even greater interest than the differences and similarities of initial bills in the three States is that the California legislature, at the request of fishermen, adopted a permanent limited-entry programme in 1982 which changed the licence from association with the fishermen to association with the vessel and made licences transferable. These changes were identified by fishermen who had discussed these features at great length.

Stated objectives of all three programmes were quite similar to those in areas already described - to improve the economic health of the industry while meeting resource-conservation commitments. In each case motivation was associated with the conflict between a fleet size which had grown too large and severe difficulties in meeting spawning-escapement goals. Detailed evaluation is quite difficult, both because these programmes are relatively new and because of the impact of other developments. Nonetheless, a general impression emerges that the high profile of fishermen in programme design, ease of entrance qualifications, minimal fleet reduction policies and low licence fees have tended to lead to high political feasibility, acceptable administrative feasibility, low programme costs, contentious but relatively satisfactory equity treatment and minimal impact on either resource-conservation or economic-efficiency goals.

Wisconsin, Michigan, and Ohio

The Great Lakes, which separate the United States and Canada in the middle of the North American continent, have long provided rich fishery resources to both countries. Early in this centry, several lakes had important commercial fisheries. However, the commercial fisheries have tended to decline for a number of years because of environmental degradation, growing pressure to reallocate fish to recreationists and assertion of Indian fishing-rights claims. Following a rapid growth in commercial fishing regulations, Wisconsin authorized limited entry on Lake Superior in 1967 and Lake Michigan in 1978. Michigan created a licence limitation programme on Lake Michigan in 1968 and Ohio passed a limited-entry law dealing with Lake Erie in 1974.

Although these inland fisheries will not be discussed at length, a few key features are worth noting. The discussion of the Alaska and British Columbia limited-entry programmes included references to the desire by some to shift the growing commercial fishing industry toward more professional, full-time fishermen. In the Great Lakes, qualification criteria were used vigorously to shift a declining labour force toward more participation by professional, full-time fishermen with the hope of drawing qualified young people into the industry. Qualifications include historic landings at a significant level. All three States have sharply increased licence fees, in large part to remove the part-time fishermen. All States have licences which are transferable through the state fishery management agency. This agency attempts to discourage, but not to stop, transfers. Licences are tied to vessels, with various additional stipulations about vessel ownership. Michigan has employed a buyout programme, funded out of State revenues, to reduce gillnet gear. In 1975, a quota-shares programme was established in Michigan for chubs.

The Wisconsin and Michigan programmes were introduced at fairly modest scale with substantial changes in 1978 and 1974, respectively, and the Ohio programme began in 1974. Evaluations written in 1978 suggest that the programmes were designed for equity and resource-conservation reasons, subject to administrative feasibility constraints. Economic efficiency was not directly identified as an important goal. Although concern was expressed with respect to some stocks, licence control appears to have enhanced effective management. Key equity goals have related to reducing sport vs. commercial conflicts. Although conflicts remain, the consensus appears to be that limited entry has been helpful.

New England

The discussion of Atlantic Canada included a reference to numerous, complex factors which evolved over many years of harvesting the very valuable fishery resources in the North Atlantic Ocean off the coasts of the United States and Canada. Perhaps because of the complexity of these factors, limited entry has found very little application, although it has been and continues to be widely discussed. However, the same highly valuable and vulnerable fishery to receive the first modern limited entry programme in Canada has also led to licence limitation in New England.

Informal property rights have played an important role in limiting access to some lobster resources in New England (Acheson, 1975). Fishermen tend to work areas which they have worked in the past. Violation of this practice has led to violence against the interlopers, sometimes to their persons but most commonly in terms of damage to their gear. However, property rights which are not enforceable by law were eroded by the growth in the value of the resource and the shift of harvesting activities further out to sea.

Two New England States, Maine and Massachusetts, responded to the over-capitalization of their lobster fisheries with attempts at limited entry. In 1975, Maine froze lobster licences and attempted to develop a permanent system for restricting licences. Political feasibility within the State required discrimination against non-residents which, in turn, was not acceptable in federal courts. Rather than pursuing the matter further, as was done in Alaska, the matter was dropped. However, discussions alone have been credited with significantly increasing participation. When discussions were dropped, participation rates also fell. On a parallel note, a moritorium on new lobster licences was passed in Massachusetts in 1975. While the number of licences issued in 1975 was virtually the same as in 1974, the number of licences reporting jumped from 876 to 1,201. Effort then rose, with the number of pots fished growing by 10 percent between 1975 and 1977 (50 percent between 1974 and 1977). These numbers illustrate one conclusion reached in many other areas as well - if the **only** thing you do is

place a moritorium on the numbers participating in a fishery, the short-run effect will be to increase fishing effort, leading to negative impacts in terms of economic efficiency, resource conservation and, probably, equity. If one is not willing to take other steps, that first step (moritorium) should be very carefully considered.

Mid-Atlantic Surf Clams and Ocean Quahogs

One last example of a limited entry programme in the United States is included because of a key difference with the other programmes already discussed. While the Canadian limited entry programmes have been formulated by the national government, all the United States programmes discussed so far were the result of State actions. The reason is that, while there are constitutional grounds for federal control over most, if not all, natural resources, there is a long history of delegation of natural resource management, especially fish and wildlife management, to State authorities. However, when the United States passed its extended fishery jurisdiction legislation, permission was granted for federal limited entry programmes, subject to a number of procedural limitations. The first regional planning body to authorize such a limited entry programme was the Mid-Atlantic Fishery Management Council and the fisheries so regulated were surf clams and ocean quahogs.

Surf clams are a valuable resource whose harvest grew very rapidly in the 1950s and 1960s. Although many fishing grounds were depleted, no consensus for action emerged, both because discovery of new groups kept the total harvest at high levels and because the appropriate management response would require a strong, coordinated effort among fishery agencies in States not widely known either for cooperation or coordination in natural resource management. In 1976, two events took place concurrently - total landings fell to 49 million pounds from 87 million pounds the previous year and extended fishery jurisdiction created a mechanism for regional planning efforts which could be implemented through national regulation. Consequently, a multi-State task force of agency biologists which had been working carefully with the harvesting and processing industries suddenly found themselves reporting to a planning body committed to resource conservation and possessing a mechanism to achieve such goals.

The Surf Clam and Ocean Quahog Fisheries Management Plan was developed by a body of State and Federal Agency members as well as public members close to the industry in New York, New Jersey, Delaware, Maryland and Virginia, in close consultation with a simular group in New England. The objectives of the plan, which was accepted in November 1977, were to rebuild stocks to the maximum sustainable yield level while minimizing short-term economic disruptions. A moritorium on new entry, annual and quarterly catch quotas, a limit on days and hours fished per week, restriction of fishing in areas composed of young clams and requirements for record-keeing were all enacted to reach these goals. The general consensus is that the regulations helped to prevent the collapse of the fishery and has helped to rebuild stocks. The moritorium has since been extended.

While there is consensus on attainment of conservation objectives, there is disagreement about economic effects. Some argue that the management system permitted a concentrated processing sector to depress surf clam prices. Adding this to a depressed economy, they argue that "the moritorium has had little or no effect because the economic incentives to attract new capital have not been present" (Strand, Kirkley and McConnell, 1981: p.136). A contrasting view is that "a significant upgrading of the fleet occurred in 1979, in part probably in response to discussions of a freeze on dredge size and number and in part in response to a desire to maximize harvest per unit of time in response to the management regime" (Keifer and Freese, 1981: p.139).

While the choice of moritorium combined with little direct gear control was the politically feasible approach, equity considerations made the programme a most difficult one for the decision-makers involved. Both excluded fishermen and fishermen who express concern about access for their children and crew members made renewal of the moritorium an issue which has been approved with great apparent regret. On the other hand, participating fishermen also are highly critical of other portions of the plan intended to discourage effort levels, such as the limit on hours and days of the week in which fishing is permitted. Part of the criticism should be viewed as the inevitable reaction which occurs when growing resource demand finally places great pressure on attainment of resource-conservation goals and expanded regulations become necessary. People naturally rebel against any form of increase in regulation. The question, as reflected elsewhere in this paper and other papers prepared for this consultation, is what the proper role might be for licence limitation.

RECENT TRENDS AND CURRENT CONCERNS

This paper began with a summary of certain propositions about limited entry which appeared to be fairly widely accepted in the United States and Canada in 1978. The bulk of the paper was devoted to a review of the scope of approaches taken in those two countries, the motivation for the approaches and a subjective evaluation of them in terms of economic efficiency, equity, resource conservation and political and administrative feasibility. This final section explores five themes which were emerging in 1978 and have been increasingly discussed since.

Extended Fishery Jurisdiction

Any group finds it difficult to gain acceptance for restricting use of a resource by its members when other groups are utilizing the same resource. This certainly has been the case with respect to coastal fisheries in North America. Both the United States and Canada followed the intent of most provisions of the United Nations Law of the Sea in asserting that extended jurisdiction was intended to establish resource conservation over fish populations which had become sadly depleted. Additional LOS treaty language, giving preference to coastal fishing nations, set the stage for de facto exclusive fishing access to several important fish stocks and access through bilateral or multilateral treaties for others. The perception of greater responsibility for the wise use of fish resources and greater opportunities to receive benefits from rationalization of fishery management is undoubtedly a critical factor in the careful reassessment of opportunities to use limited entry as a fishery management tool. In fishery after fishery, the decline of foreign participation is closely associated with interest in possible socio-economic rationalization of the fisheries.

In many areas, such as New England, so many fishery problems were attributed to the presence of foreign fishing fleets that the coming of extended jurisdiction created totally unrealistic expectations about improvement in fishing conditions. These expectations, abetted by public fishery development programmes and a naive acceptance of optimistic forecasts by various lending institutions, led to a rapid rate of growth in investment in the fishing industry during the late 1970s. As the over-capitalization became apparent, greater interest emerged in limited entry.

Fishery Development

Even though fishery development programmes, including low interest loans, are given a significant share of the blame for over-capitalization, these programmes stay in place largely for three reasons. First, the United States greatly resents being technologically backward in large portions of its fishing fleets with respect to other fishing nations. Thus, there is a strong desire to upgrade US fishing vessels to meet high technical standards. Second, where economic distress is currently observed, there is an understandable desire to cure these problems by identifying new fishing opportunities. If there are two many fishermen chasing species A and species B is being fished below its maximum sustainable yield, then there is a desire to entice fishermen to switch from A to B. Third, there is a strong commitment, not unrelated to the first two reasons, to reduce the foreign fishing fleet by replacing "them" with "us".

To avoid creating over-capitalization through fishery development, promotional activities and low interest loans are subsidized only for fisheries which are thought not to be fully developed. However, the nature of flexible, multi-purpose vessels implies that they can be intended for use in one fishery but will still increase the capacity of other fisheries. The very capable, efficient vessels designed to replace foreign vessels in harvesting Pacific Whiting (hake) off the Oregon coast are important contributors to the utilization of rockfish populations which appear to be greatly over-fished.

Multi-purpose and Multi-species Fisheries

Most, but not all of the licence limitation programmes described above relate either to one species or to a closely related set of species. For example, salmon licence limitation programmes relate to two or more of the five salmon species which occur significantly on the Pacific coast of North America. In several cases, introduction of limited entry programmes began with the replacement of general commercial fishing licences with newer, more complex licensing systems. New data-management systems also were created at that time.

In contrast to single-species fishery management programmes, a significant portion of United States and Canadian fishing fleets are multi-purpose operations. For example, of the 518 vessels with dungeness crab landings in Oregon in 1981, 410 also landed salmon, 185 landed albacore tuna, 87 landed shrimp, 36 landed groundfish, 161 landed both albacore and salmon as well as crab, 46 landed shrimp and albacore as well as crab, 28 landed groundfish and shrimp as well as crab, 11 landed groundfish and albacore as well as crab, and 10 landed groundfish, shrimp, albacore and crab. The point is that modern fishing vessels can participate in several fisheries and many do.

The multi-purpose character of fleets does not necessarily mean that the same limited entry programme should be applied to all. Some fisheries such as the dungeness crab fishery appears to rise and fall in long and relatively predictable cycles. Some fisheries have yields which vary little over time and still others (such as some salmon populations) vary widely from year to year but not in a predictable cycle. The best mix of traditional fishery management measures and limited entry programmes will depend upon many things including the desire by the fishing industry to avoid risk. The point is that analysis of limited entry programmes, fishery by fishery, will lead to errors including misunderstanding the effect of those programmes on economic efficiency and equity. Not only can analysis of limited entry be misleading through a failure to understand the multi-purpose character of a given gear type in a given area, but errors can occur from under-estimating the fishermen's ability to change gear types and areas when incentives are sufficiently strong.

Multi-species fisheries have also not been well analysed with respect to limited entry programmes. Limitation of effort to prevent over-fishing of some species inevitably leads to under-fishing of other species. This same trade-off is, of course, relevant for most single-species fisheries with significant sub-stocks. Licence limitation programmes in multi-species fisheries appear to meet significant resistance on political feasibility grounds and are vulnerable to equity arguments. Assessment against resource conservation and economic efficiency arguments is more straightforward but requires very careful analysis. At least some licence limitation proponents argue that a more professional fleet with be more competent in handling gear regulations designed to deal with multi-species problems. For example, the more skilled salmon trollers know how to deploy their gear to catch chinook salmon and avoid coho salmon, but others waste many coho during a special chinook-only season requiring the special gear.

Who is in Charge?

As licence limitation programmes have expanded along the Pacific coast, there has been a notable shift in the role played by fishermen. Programmes were initially designed by public agencies searching for new ways to reach resource conservation goals. Sometimes the arguments of economists were included, particularly when there was a clear view that licence limitation would also enhance economic efficiency. Fishermen were commonly hesitant and often violently opposed. Now fishermen are the advocates of licence limitation and have learned to adapt both proposals and process to meet political feasibility requirements. Government agencies provide technical advice and data but try to stay neutral on key policy decisions. Economists are also keeping a rather low profile - they are not certain that economic efficiency will not be enhanced but neither are they as certain of outcomes as they once were.

This high profile of fishermen in programme design not only enhances political feasibility but aids administrative feasibility. Economic efficiency is not likely to change much; indeed, many fishermen would reject this as an objective which should be emphasized. Attainment of resource conservation goals is as satisfactory here as it is with programmes initiated by agency personnel. The critical difference may well be due to a different approach toward equity.

Equity judgements often depend upon how one defines the groups which are being affected. Public participation is strongly stressed in defining political feasibility.

In the United States, public participation in fishery management consists of several elements. One is a series of public hearings in a relatively small number of fishing communities, where the feeling of the public is associated with the number of individuals who argue certain points, their ability to articulate their views and, sometimes, the number of people who applaud or make derogatory remarks as speakers make certain statements. A second consideration is the written record - this also relates to the number of written remarks and their persuasive power. Finally, elected or appointed members from fishermen's associations have additional opportunities to express their views.

None of these communication channels obviously reflects the general view of fishermen. Full-time fishermen are more likely to have their view-points emphasized than part-timers. High-income fishermen are also more likely to be heard. More emotional fishermen are more likely to be heard. Several other factors are also relevant. The important point is that shifting sole responsibility for design of any fishery management programme, but especially limited entry, to "the fishermen" is really to give some groups an advantage relative to others.

Limited entry will lead toward certain objectives only through sacrifice with respect to others. Since many of the important consequences are gains by some groups and either losses or smaller gains to other groups, careful attention to equity is required. Integral involvement of fishermen in design of fishery management measures will greatly enhance key objectives including political feasibility. However, if policy makers do not stay involved, all view-points will not be reflected. A cooperative approach may require new and innovative ways for fishery managers to stay in touch with all of the people affected by their decisions.

REFERENCES

Acheson, J.M., 1975 Fisheries management and the social context: the case of the Maine lobster fishery. Trans.Am.Fish.Soc., 104:653-68

Adasiak, A., 1980 The Alaskan experience with limited entry. In Limited entry as a fishery management tool, edited by R.B. Rettig and J.J.C. Ginter. Seattle, University of Washington Press for Washington Sea Grant, pp. 271-99

Canadian Department of Fisheries and Oceans, 1981 Policy for Canada's Atlantic Fisheries in the 1980s: a discussion paper. Ottawa, Canadian Department of Fisheries and Oceans, 68 p.

_____, 1982 Task Force on Atlantic Fisheries, issues and options. Ottawa, Canadian Department of Fisheries and Oceans, 18 p.

Crutchfield, J.A., 1979 Economic and social implications of the main policy alternatives for controlling fishing effort. J.Fish.Res.Board Can., 36(7):742-52

Keifer, D.R. and S.P. Freese, 1981 Comments on economic analysis and the management of Atlantic surf clams. In Economic analysis for fisheries management plans, edited by L.G. Anderson. Michigan, Ann Arbor, Ann Arbor Science, pp. 138-41

Morehouse, T.A. and G.W. Rogers, 1980 Limited entry in the Alaska and British Columbia salmon fisheries. Anchorage and Juneau, Institute of Social and Economic Research, University of Alaska, 291 p.

Mundt, J.C. (ed.), 1975 Limited entry into the commercial fisheries. Seattle, Institute for Marine Studies, University of Washington, 143 p.

Pearse, P.H., 1979 Symposium on policies for economic rationalization of commercial fisheries. J.Fish. Res.Board Can., 36(7):711-866

_____, 1982 Turning the tide: a new policy for Canada's Pacific Fisheries. Ottawa, Canadian Department of Fisheries and Oceans, 292 p.

Rettig, R.B. and J.J.C. Ginter (eds), 1980 Limited entry as a fishery management tool. Seattle, University of Washington Press for Washington Sea Grant, 463 p.

Strand, I.E. Jr., J.E. Kirkley and K.E. McConnell, 1981 Economic analysis and the management of Atlantic surf clams. In Economic analysis for fisheries management plans, edited by L.G. Anderson. Michigan, Ann Arbor, Ann Arbor Science, pp. 113-38

Appendix A

Objectives for Limited Entry Programmes

Numerous objectives have been identified by those who have formulated limited entry programmes in the United States and Canada and those who analyse them. The following list is intended to be fairly complete but not exhaustive. Several overlap and may be duplicative:

1) Maintain the economic viability of fishing units

2) Maintain the economic viability of processing establishments

3) Prevent the over-exploitation of fishery stocks:

   a. Prevent fishing pressure which could impair the reproductive capacity of any valuable species

   b. Avoid the capture of fish at ages and sizes such that the growth rate exceeds the natural mortality rate

4) Reduce wastage of fish due to discards

5) Improve vessel safety and comfort

6) Promote the availability of quality seafood to the consumer

7) Maximize the total net income of the fishing fleets

8) Maximize the total net income of processors

9) Maximize the net national income

10) Provide for an orderly fleet expansion where capacity is less than optimum yield

11) Provide for the wise and full utilization of fishery resources over time (conservation)

12) Minimize costs of management, including data collection, research, administration and enforcement

13) Increase the flexibility of the fishery management process

14) Increase the flexibility of commercial and recreational fishermen and associated industry to conduct their affairs

15) Enhance security (i.e., minimize instability due to government action)

16) Minimize annual variability of industry income

17) Maximize public revenues

18) Simplify fishery management

19) Maintain the integrity of data

20) Bargaining power:

   a. Increase the bargaining power of fishermen vis-a-vis first buyers (usually processors)

   b. Increase the bargaining power of first buyers vis-a-vis fishermen

   c. Provide for a more competitive industry (reduce bargaining power of both fishermen and first buyers)

21) Reduce negative attitude of fishermen toward management agencies

22) Protect "our" fishermen from other groups (n-1 factorial objectives for n groups)

23) Reduce indebtedness/increase the net worth of fishermen

24) Provide for reasonable economic returns (a trade-off between increasing fishermen's incomes and creating an elite class)

25) Avoid creation of special or elite status for a portion of the fishermen

26) Provide for orderly fishing (a blend of conservation, enforcement costs, fishermen's costs and other objectives)

27) Provide for an acceptable mix of individual, relative to corporate, ownership of vessels (often stated as minimizing corporate ownership, provoding for ownership by natural persons only or avoiding processor control of ownership)

28) Provide an equitable distribution of income (not the same as equal, consequently a highly elusive concept)

29) Provide opportunities for technological improvement

30) Increase the professionalization of the fleet (mixture of "me-them", product quality, vessel safety, management cost and other objectives)

31) Increase the diversification of the fleet

32) Achieve preferred balance of part-time versus full-time fishermen (again a complex mixture of other objectives)

33) Minimize the dislocation of social groups

34) Reduce user-group conflicts

35) Freedom objectives:

   a. Maintain life-style objectives of fishermen, especially independence, challenge, lack of regimentation, being outdoors, sense of identity and pride in occupation

   b. Protect minority rights

   c. Maintain flexibility in choosing occupation, including target species, size and type of vessel and gear, geographical mobility and time of year to fish. This objective reflects both ease of entry and ease of exit

36) Equity (also relates to several listings above):

a. Distribution of catch among groups must be considered fair. This is usually stated in terms of every year but sometimes applies to an average over a few years

b. Allocation of access (seasons, gear restrictions, area closures, etc.) to different groups considered fair

c. Processes leading to management options which affect different user groups considered fair

Appendix B

Concerns Expressed About Limited Entry Options

During discussions of limited entry alternatives in the United States and Canada, a number of concerns have been expressed. Those views which this author believes to be most substantive and/or most widely held have been discussed in the text above. This section summarizes many, but not all, of the argument in text and adds several more.

Licence Limitation

(1) Input stuffing (see Wilen, Pearse and Wilen - articles in Pearse, 1979).

(2) "Soft" programmes (California troll) actually encourage excess capacity and are counter-productive.

(3) Programmes which are not "soft" lead to significant court challenges and require a significant, troublesome and costly public presence (Alaska net salmon).

(4) Licence limitation in one fishery (e.g., Alaska king crab) will impede desired expansion of under-developed fisheries (e.g., Alaska groundfish), given the multiple purpose design of vessels involved.

(5) Technological advance may be distorted (cf. (1)) in both the short and long run.

(6) Licence limitation is not expected to be flexible enough to accommodate changing values, abundance and availability of fish.

(7) Licence limitation is directly in conflict with the freedom of individuals:

a. Is socialistic (communistic)
b. Is un-American
c. Is anti-free-enterprise

(8) Will lead to greater government control.

(9) Will lead to a new unwieldy bureacracy.

(10) Will cause a loss of traditional independence:

a) Will cause a change in lifestyle

(11) Once adopted, it cannot be phased out.

(12) A few large firms will control fishing.

(13) Since licence limitation is used only after too many are "in", those kept out or forced out will see the entry (exit) criteria as innately unfair.

(14) **Discussion** of licence limitation **increases** entry and causes unwise speculative upgrading (enlargement) of vessels to beat qualifying dates.

(15) Not needed for conservation (the only acceptable objective).

(16) Since entry capital (cost of licence) has increased, our sons and daughters are driven from a family tradition:

a. Since, crew advancement is stymied and it becomes difficult to enlist crews

(17) Creates a Millionaire's Club.

(18) Licence limitation is solely a device to protect a politically influential group from interlopers and hence is an inappropriate action for federal support.

(19) Alaska licence limitation (detailed form) freezes technology.

(20) Mobility (a good thing) is reduced.

(21) A deep commitment to reduce effort levels is needed for more good than harm to occur; the vast majority of licence limitation programmes go no farther than freezing status-quo vessel numbers.

Royalties (Taxes)

(1) The FCMA severely restricts the ability of the federal government to impose fees.

(2) While States can and do impose poundage taxes, the relevant political processes are protracted and work only with great costs and a long-time lag.

(3) Recent fleet-switching behaviour studies confirm the arguments of anthropologists that changes in relative prices work rather weakly in changing short-run decision-making (although fishermen process such information quickly and rapidly revise their expectations), hence a second response lag will retard (the first being a lag due to a political-process response) the change in effort level, given a proposed change in taxes.

Note (2 & 3):
Since environmental variation will cause optimum effort to vary from year to year, and other lags (recognition, data analysis) exist, taxes are one of the least "flexible" tools available.

(4) Studies referred to in (3) also suggest that some groups of fishermen are capable of switching fisheries more rapidly than others. Hence, some fishermen groups will bear little economic hardship and others may be severely affected economically.

(5) Some limited entry is never discussed seriously until fisheries are over-capitalized and, since entry and exit are asymmetrical (the old putty-clay capital issue), very high levels of taxes would be required to reduce effort levels. Since limited entry is also not discussed until many fishermen have come on hard times, this leads to the "hit 'em while they're down" political objective:

a. Since environmental variation requires lower effort at the same time landings are down, short-run variability in tax rates is also a "hit 'em while they're down" Catch-22.

(6) Analysis of price controls in fisheries and elsewhere in the economy suggests that problems will continue to crop up as fishermen and processors learn how to beat the system:

a. If ad valorem taxes are assessed on fishermen, one might anticipate decreased prices and increased bonuses, direct loans (and similar "grants") to fishermen. If taxes vary from species to species, expect low prices and trip limits on controlled species and bonus prices for other species with an understanding that these buying arrangements hold only when limited species are supplied. If taxes are per-number or per-unit-weight, expect errors in reported species composition in sales. Avoidance of such practices will require significant enforcement costs.

b. If taxes are assessed on processors, similar problems will emerge. State-to-State cooperation to provide timely management may be harder here than with management of fishermen, due to lack of experience of States in such cooperation.

(7) When revenues from taxes go into a general fund, the person paying the taxes is among the group with highest political standing with fishery decision-makers, while the beneficiary is a diffuse and often resented bureacracy. This further reduces its political viability. With this issue confronting fishery agencies vis-a-vis current proposals to collect "user fees" for Coast Guard services, fishery managers will not want to touch this can of worms.

(8) The incentive to under-report and mis-report landings impairs information needed for other fishery management objectives.

(9) Only large operators will have money to pay extra costs; little guys will be driven out of the fishery.

(10) This tool is not needed for conservation which is, after all, the only valid objective.

Individual Fisherman Quotas (stock certificates, shares)

(1) Since fish are res nullius, State and Governments do not own them in the same way Governments own trees. Hence, the public cannot cede rights to specific animals, only access and landing privileges.

(2) Since IFQs have been implemented in so few instances, Murphy's Law will work with fury, i.e., we know that "there will be many a slip twixt the cup and the lip".

(3) Also due to lack of experience with IFQs, adoption of such a novel programme would only be possible after a massive educational effort.

(4) IFQs will lead to greater government control:

a. IFQs will lead to a new bucreacracy
b. IFQs will cause a loss of traditional independence
c. IFQs will force an unwanted change in lifestyle
d. IFQs will restrict freedom

(5) A few large firms will capture control of fisheries through monopolizing IFQs.

(6) IFQs are not needed for conservation, hence are not needed.

(7) Value of IFQs increase startup capital costs, keeping sons and daughters out of the industry and reducing incentives for crew advancement, in turn making it difficult to hire crews.

(8) Information costs to manage fisheries become higher because fleet management is replaced by vessel management.

(9) In multi-species fisheries, fishermen will increase wastage (discards) when they have reached their IFQs on some species but not on others. In single-species fisheries, fishermen man increase discards if price or IFQ rules encourage a catch composition of larger size and/or higher quality.

(10) IFQs may require at-sea monitoring and enforcement which will be both unpopular and costly.

(11) IFQs will lead to a Millionaire's Club.

(12) IFQs will work only in fisheries which have overall quotas. Since overall quotas are not acceptable at all in pink shrimp, dungeness crab and albacore tuna fisheries, and since there is keen resistance to quotas in troll salmon, groundfish, and in the PFMC area for Pacific halibut, IFQs do not seem operational or at least of limited usefullness.

(13) If adoption of IFQs allows for an expanded season, enforcement would have to take place over a longer period of time and would, hence, become more costly.

(14) IFQs would appear to reduce risk. While most analysts interpret this as a benefit, some fishermen prefer a lottery with expected value, X_1, to a sure outcome of X_2, where X_1 X_2.

(15) IFQs create an incentive to under-report which will cause a deterioration in the data base needed for other management actions.

(16) Criteria for initial location of IFQs may create incentives to fish harder before the programme begins (i.e., an incentive is created to maximize eligibility for IFQs).

UNITED STATES FISHING EFFORT RESTRICTIONS AND FISHING VESSEL LICENSING, UNDER THE 200-MILE LIMIT

by

William D. Chappell
Operational Law Enforcement Division
US Coast Guard Headquarters
Washington, D.C., USA

HISTORY

The Magnuson Fishery Conservation and Management Act of 1976 (MFCMA), enacted on 13 April 1976, declared a United States Fishery Conservation Zone (FCZ) from the seaward edge of the territorial sea out to 200 miles from the baseline (200-mile limit) for exclusive US management of fisheries except highly migratory species (tuna). It restricted but did not entirely eliminate foreign fishing. The MFCMA also specified standards to manage both foreign and domestic fisheries and designated Regional Fishery Management Councils to do the actual management. It designated the Department of Commerce/National Marine Fisheries Service to manage the fisheries on the Federal level, and designated the National Marine Fisheries Service and the US Coast Guard jointly to enforce the MFCMA and its regulations. These enforcement powers may be delegated to the States for enforcement on domestic vessels.

CURRENT MANAGEMENT OF FISHERIES

The eight Regional Fishery Management Councils created by the MFCMA manage the fisheries within their area, subject to the approval of the Secretary of Commerce. Each council issues fishery management plans controlling both foreign and domestic fishing for each fishery in need of regulation. Two or more councils may issue joint plans when stocks cross regional boundaries. The National Marine Fisheries Service issues regulations for approved fishery management plans which cover the management and enforcement aspects of the fishery. These regulations in turn are enforced jointly by the National Marine Fisheries Service and US Coast Guard. Management of the domestic and, to a lesser extent, the foreign fisheries are influenced by the makeup of the councils. The voting members of the councils are made up of the National Marine Fisheries Service Regional Director, the head of the State law enforcement agency responsible for fisheries management in each State represented on the council, and members of the fishing industry and scientific community nominated by the State Governors and appointed by the Secretary of Commerce. Non-voting members of the council include the local US Coast Guard District or Area Commander, the US Fish and Wildlife Service Regional Director and a representative of the Department of State. This membership must resolve hard questions concerning biological, technological, economic, social and political factors to manage the fisheries. They must balance the biological requirements to maintain or rebuild the fishery against the technology involved in catching the fish along with the economic, social and political factors driving the fishery.

Once conservation goals have been set in a fishery, management measures must be considered. They should respond to the scientific data requirements to manage the fishery, be biologically sound and be compatible with the technology used in the fishery. They should minimize their intrusiveness into the fishing economy and should address sociological requirements to preserve or improve the local society. They should minimize enforcement requirements consistent with achieving management measures. Finally, they should minimize the costs of management in order to maximize benefits to society.

Fishery management measures may be grouped into three areas: quotas, permits (licences) and effort restrictions. United States fisheries management under the MFCMA includes elements of all of these. Quotas on the overall catch and specific allocations to countries are used in the foreign fisheries. Many domestic fisheries also have quotas limiting catch. With the notable exception of foreign fisheries, United States quota restrictions are primarily enforced from dockside or through statistical sampling. The United States uses permits or licences primarily as a means of identification of fishing vessels. Only in a few specific domestic fisheries have they been used to restrict effort. Permits can be considered as a part of the third group of measures, effort restrictions. They are used in all fisheries in their many forms.

Enforcement is the means to maintain this balance between the biological and the other factors affecting a fishery. Because of the variation of these factors among the stocks and the fisheries, some management measures work better than others for a specific fishery. The application of effort restrictions as a part of managing the fisheries will be discussed.

EFFORT RESTRICTIONS ON ENFORCEMENT MEASURES

Managers, as previously stated, must consider many factors when they decide on management measures. In deciding on effort restrictions they must consider all the aspects of a fishery if they are to realize the full benefits of their effort. One measure may not be as sound as another biologically. The second measure may require more enforcement than the first due to the ease by which it is avoided. More enforcement means increased cost and the increased cost must be weighed against the benefit of the effort restriction. The availability of resources and their costs to enforce a certain measure is also a major factor in determining the appropriate measures to use.

Effort restrictions can be broken down into several general categories. A combination of several effort restrictions may apply to any one fishery as necessary to effectively manage it. No one requirement is a pre-requisite for another. More complete descriptions and some of the advantages and disadvantages are discussed in succeeding sections.

Effort restrictions used on both foreign and domestic fishing vessels by the United States fall into the following categories:

Permits or Licences

Reports and Statistical Record-Keeping

Gear Reporting and Marking Requirements

Closures of an area by period, species or gear

Seasons by area, species or gear

Gear Restrictions

Size/Sex Restrictions

Prohibited Species Retention

Facilitation of Enforcement Provisions

EFFORT RESTRICTIONS ON FOREIGN VESSELS

Foreign vessels fishing within the FCZ of the United States are subject to very specific requirements. A nation must conclude an international fisheries agreement with the United States prior to its vessels being allowed to fish in the FCZ. This agreement requires the nation and its vessels to comply with appropriate regulations; allow boardings, inspections, searches and seizures by US enforcement officers; post permits on each vessel; allow transponders and observers on board all vessels; maintain an agent in the United States for service of legal documents and assessments of fines; and pay appropriate fees.

The permit (or licence) issued to each foreign fishing vessel specifies in what fishery it may conduct operations and what kind of operations it may conduct. Fishing operations are catching, processing, support (cargo and personnel transfer) and joint venture (over-the-side receipt of fish from US catcher vessels). The permit also serves as an agreement by the vessel to abide by the terms of the fisheries agreement, the fishing regulations and any other special terms attached to the permit.

Each vessel must keep records and make reports regarding its catch and movements. Catch reports are used in quota management but do contain information on movement of the vessel. These reports help to determine the concentration of fishing activity and may determine the vessel's presence in a closed area.

Foreign vessels must identify themselves by their International Radio Call Sign marked on the sides and a weather deck of the ship to allow easy identification by enforcement aircraft or vessels. Marking also applies to fishing gear not attached to the vessel such as longlines or crab pots. Each vessel must monitor and avoid the locations of US fixed gear (lobster traps, crab pots or other gear attached to the bottom), which are broadcast by radio in notices to fishermen, and must avoid conflicts with fixed gear wherever found. Each vessel must report any gear brought up in a trawl or any conflict with another vessel's gear.

Closures are the most pervasive effort restriction used in the United States. Closures should be defined as a prohibition on fishing in a certain area within a fishery for a period of time. The closure can be year around or for only a short time. The closure can be limited to retention of certain species (i.e., herring or flounder) or certain types of gear (i.e., trawling or longlining). The largest closures off the United States are those prohibiting foreign vessels from catching fish within 12 nautical miles of the continental United States. Closures exist in the Gulf of Mexico to protect coral reefs, in the Gulf of Alaska to prevent gear conflicts with the US crab boats, in Bristol Bay, off Alaska, to protect young crab and halibut, and off the Columbia River of Oregon and Washington, to protect migrating salmon and allow recreational fishing. They can be as small as a few square miles or large as many thousands of square miles.

Seasons are the inverse of closures. They open an otherwise closed area to fishing for a portion of a year. The season may affect the entire fishery or a sub-area of the fishery. It might also apply to fishing for a particular species or with a type of gear (i.e., bottom trawling). A fishing season exists for active trawling within the Eastern Pacific FCZ off the coasts of Washington, Oregon and California from 1 June until 1 November for each year. The five fishing areas off the Atlantic should be considered seasonal.

Gear restrictions may be defined as any management requirement which regulates the devices used to catch fish. Foreign gear restrictions include trawl mesh sizes in the Atlantic and Eastern Pacific, and hook size for shark fishing in the Atlantic Ocean and Gulf of Mexico. Bottom trawling is also prohibited at certain times in the Eastern Pacific, Western Atlantic and Gulf of Alaska.

Size and sex restrictions on foreign catch apply only in two specific cases. Regulations for the Tanner crab fishery in the Bering Sea prohibited the retention of female Tanner crabs or any crab of the species, Chinocetes bairdi, caught south of 58°N latitude. This restriction was made moot after 1980 when no more foreign quotas for Tanner crab were offered because of increased domestic catch. Canadian and US longline vessels fishing for halibut under the International Pacific Halibut Convention are not allowed to retain halibut under a minimum size.

The non-retention of prohibited species by foreign vessels remains an important element in US fisheries management. Besides lobster, crab and other bottom dwelling marine animals protected under previous US law, prohibited species now include salmon, halibut, Pacific herring and any other species for which a vessel does not have an allocation. These species must be returned to the sea immediately regardless of condition. Billfish caught incidentally by longline vessels fishing for tuna must be released by cutting the line to the hook before the fish is removed from the water.

Foreign vessels must conform with regulations which facilitate enforcement operations. These requirements include stopping or going slowly to allow a small boat to come alongside, providing a ladder, handline and illumination to allow the boarding officers to board safely and taking other actions to facilitate boardings and inspection. Vessels must guard the radio frequencies of 2182 Khz and 500 Khz daily between 2000 and 2030 GMT when they have the capability.

EFFORT RESTRICTIONS ON DOMESTIC VESSELS

Effort restrictions on domestic fishing vessels are similar to those on foreign vessels but the specific regulations vary widely from fishery to fishery. United States domestic fishing operations are still relatively simple when compared to foreign operations but are comparable biologically and technically. However, economic, social and political factors often over-shadow the other factors and control the management of the domestic fishery.

Not all domestic fisheries require vessels to have permits. They have been instituted only where permits are necessary for statistical purposes or to limit entry into the fishery. The surf clam and ocean quahog fishery off the mid-Atlantic States of New Jersey, Delaware, Maryland and Virginia is the only fishery which has limited entry. There has been a moratorium on new vessels in this fishery since 1977, due to over-capitalization and depletion of the resource.

Record-keeping and reports vary from specific log-keeping requirements for all vessels to voluntary reporting. There is a trend in new fisheries regimes toward mandatory collection of statistics from representative samples of fishermen rather than log-books for everyone. Fisheries statisticians collect data without providing access to enforcement personnel. This preserves the confidentiality of the fishing area while encouraging honest statistical reporting.

The only reporting requirements for domestic vessels are in the surf clam and ocean quahog fishery. A vessel operator must report losing a day of fishing to bad weather if he wishes to claim another day of fishing. A proposed rule would require domestic vessel fishing in the spiny lobster fishery of the Western Pacific Ocean to report intended landings of spiny lobster outside the State of Hawaii in order for inspectors to observe the catch. The management councils continue to debate mandatory reporting of fixed gear such as lobster pots but no regulations have been issued.

Most domestic fisheries regulations require a vessel in the fishery to be marked, usually with its Official Number (a hull identification number). A vessel under five net tons must be identified by a State registration number. All fisheries that require permits require vessel marking. Fixed gear is also required to be marked above the surface to help identification.

Domestic fishing closures are generally smaller than those for foreign closures. They range from haddock spawning closures for three months on Georges Bank in the Atlantic to areas closed to surf clam and ocean quahog fishing because of pollution in the Atlantic off New Jersey. Other closures prevent domestic gear conflicts, such as one in the Gulf of Mexico off Florida separating stone crab fishermen fishing with pots from shrimp trawlers.

Several fisheries use seasons as their primary management measure. The Alaska and Eastern Pacific (coasts of Washington, Oregon and California) salmon fisheries, the Pacific halibut and the Tanner crab fisheries use seasons and break the fishery into areas to allow for closures during the seasons. The northern anchovy fishery off California and the stone crab fishery off western Florida in the Gulf of Mexico also have seasons.

There are many different kinds of gear restrictions in the domestic fisheries. The most familiar are mesh size restrictions in the groundfish fisheries. The Atlantic grounfish fishery has a large mesh area where small mesh nets can be used only by special arrangement, although they can still be on board. Traps or pots are the only gear allowed to take crab and spiny lobster. All traps must have degradable escape panels which disintegrate after a period of time if the trap is lost. Tanner crab pots must also have escape rings for under-sized crabs. Some salmon may only be taken by hook and line and in some cases only with barbless hooks. Powered retrieval gear is also restricted. Halibut may only be taken by longlines.

Size and sex restrictions vary according to the fishery. The Atlantic groundfish, salmon, halibut, spiny lobster and several proposed fisheries have size restrictions for both recreational and commercial catches. Bag limits, considered a form of quota, also limit recreational fishing. Size limits and/or meat counts apply in the scallop and the surf clam and ocean quahog fisheries. Female and under-sized Tanner crab must be returned to the sea when caught. Only one claw from each stone crab may be taken and the crab itself returned to the sea. Egg laden or "berried" female spiny lobsters must also be returned.

Some species, because of their value, their small quotas, and the effort restrictions in their fisheries, are considered a prohibited catch for any gear except for those specifically authorized. These species are salmon, halibut and Tanner crab. They must be returned to the sea immediately with a minimum of injury when caught by unauthorized gear.

Domestic fishing vessels must facilitate enforcement like foreign vessels. Since there is usually no language barrier, the normal method of communicating with domestic vessels is by VHF-FM radio rather than by signal lights or flags. Signal lights or flag provisions are retained for vessels with no radio or otherwise refusing to stop. Other facilitations of enforcement restrictions are simplified for the small domestic vessels.

ENFORCEMENT OF EFFORT RESTRICTIONS

After determining what effort restrictions might be appropriate to a fishery, the mode of enforcement must be considered. Whether or not the measure can be enforced by dockside inspections, observers on the vessels, boardings from boats or ships or aircraft over-flights becomes critically important when it comes time to pay the enforcement bills. Unfortunately, cheaper enforcement modes do not lend themselves well to enforcement of effort restrictions.

The cost of different enforcement modes varies enormously. Costs of United States resources are listed as comparisons. They demonstrate the importance of carefully determining the management measures used in a fishery.

Some modes are not as effective as others in enforcing effort restrictions. Their capabilities must be considered in light of their ability to perform law enforcement tasks. These tasks can be defined as surveillance, detection, identification, classification and apprehension.

Resource	Cost 1/
Fishing Vessel Observer on board the vessel	$200 per 8-hour day
National Marine Fisheries Service Agent dockside inspection	$227 per 8-hour day
Small boat under 53 ft (16 m)	$600 per 8-hour day
US Coast Guard Patrol Boat 95 ft (29 m)	$4,400 per 24-hour day
US Coast Guard Medium-Endurance Cutter 180-210 ft (54.9-64 m)	$23,712 per 24-hour day
US Coast Guard High-Endurance Cutter 311-378 ft (91.8-115.3 m)	$39,648 per 24-hour day
Charter Aircraft cruising speed of 150 knots for about 4 hrs	$400 per hour
US Coast Guard Medium-Range Recovery Helicopter (HH-3F) cruising speed of 126 knots for 3 hrs 45 mins	$2,001 per hour
US Coast Guard Long-Range Search Aircraft (HC-130H) cruising speed of 300 knots for 11 hrs	$2,479 per hour

1/ Costs are average estimates for Fiscal Year 1982 (1 October 1981 to 30 September 1982)

Surveillance - is the amount and frequency of enforcement coverage of the fisheries area. Since the entire FCZ covers 2.2 million square miles, this task is significant. The Coast Guard has adopted a concept of patrolling the fisheries only in certain areas and at certain times of the year when fishermen operate in only those areas. While this approach does not apply to highly migratory species such as tuna, and therefore tuna longliners, it enables concentration of effort in a much smaller area of about 459,000 square miles. Surveillance of even this area is best accomplished by aircraft, as vessels are too slow for effective coverage. Satellite coverage could significantly improve efficiency at some unknown cost.

Detection and identification are closely related. Detection is the probability of locating a vessel in the patrol area. Identification of the vessel includes determining the type of vessel (i.e., fishing, non-fishing, catcher, processor), its nationality and its name or call sign. Aircraft are also best at performing this task in good weather and during daylight; however, vessels are also very good at doing this, particularly in darkness or bad weather. Patrol and small boats are also useful. Improved night vision devices and electronic sensors such as infra-red radar and side-looking radar can significantly improve aircraft and vessel performance. Transponders activated by a satellite or aircraft and fishing vessel transmit terminals transmitting via satellite have the potential for greatly improved detection and identification of vessels cooperating by having the devices on board.

Classification - is determining the vessel's actions and if there has been a violation. The ability of an enforcement mode to classify a violation depends on the effort restriction being enforced. Aircraft can classify most closed area and season violations as well as some marking and gear restrictions but cannot determine size, sex or prohibited species restrictions. Observers can classify all of these violations but may have difficulty catching short incursions into closed areas or covert retention of prohibited species due to their primary role as data collectors. They cannot be realistically employed on domestic vessels. Dockside enforcement agents can only classify those violations which apply everywhere, such as general gear or size/sex restrictions. Vessels have the ability to do all these things plus the possibility of apprehending the violator.

Apprehension - is notification and/or seizure or arrest of the violator. Citations (written warnings) and violations (civil penalty actions) can be initiated from reports by aircraft or observers but not directly delivered to the vessel. Only enforcement officers boarding from ships or boats and enforcement agents boarding from dockside can directly issue Citations, initiate Violations, arrest a person or seize a vessel. This immediate action is of value in deterring future violations, although it has yet to be quantified.

PROBLEMS IN ENFORCING EFFORT RESTRICTIONS

There are specific problems in determining the amount of enforcement needed for effort restrictions. The first is the economic incentive to violate the restriction. If a lot of money can be made with a low risk or even a high risk of short duration, such as fishing in closed areas, more resources are needed than for other restrictions of a similar nature in other fisheries. The costs of enforcement is always a factor. Expensive and scarce resources should not be squandered on fisheries which are of little economic or social value. The following examples give a better feel for the effectiveness and problems with effort restrictions.

Permits or licences are necessary for foreign vessels if they are to be controlled. Neither quota nor effort limitations on foreign vessels can be effective if their numbers are unknown. The presence of unpermitted vessels can only be discovered by vessels or aircraft.

Limits on the number of days a vessel may fish requires a mandatory check-in/check-out system with daily dissemination of data to field units. This system requires extensive communications facilities. Foreign vessels currently operate under a similar but less restrictive system. Verification is only possibly through enforcement efforts by vessels and aircraft.

Vessel and gear marking greatly facilitates fishing vessel identification by cutters and aircraft. This reduces enforcement costs by saving time and fuel and enables fishing vessels not requiring boarding to continue fishing unimpeded.

Closed areas and seasons are effective but enforcement resource requirements can vary dramatically for different fisheries. Requirements are much higher for effective enforcement in areas in which a short stay can catch enough fish to make the risk acceptable. There must be sufficient enforcement presence to insure the perception of being apprehended remains high. At-sea enforcement by vessels and aircraft is therefore mandatory. Observers can detect but not stop closed area and season violations for the vessels they are on.

Restricting fishing to daylight only can be an effective management tool but may require a high level of sophisticated at-sea enforcement. Since not all contacts at night are necessarily fishing, they must be identified by some other means such as forward-looking infra-red radar (FLIR), night-vision devices, or closing and identifying each contact by spotlight; the latter being particularly unacceptable to all vessels.

Assigning each vessel a specific fishing time increases enforcement requirements, as each contact must be identified. If vessels can vary their daily fishing times, a 24-hour real-time check is required, with close monitoring by at-sea enforcement; a very expensive measure.

Gear soak times limiting the time gear may remain in the water untended, unless at the beginning or end of a season, are generally unrealistic, as they require dedicated resources, i.e., a policeman patrolling a 2-hour parking area and checking each car every 15 minutes. This must be done by boats and vessels at sea.

Limits on the number of traps or pots allowed to be fished present similar problems to soak times, since each trap must be counted and positively identified. Limits on numbers of pots in a string are also difficult to enforce without an on-scene presence, as strings are easily ganged together. Conversely, marking of pots and length of string requirements are easily enforced at sea, if the strings and pots are identified on the buoy.

Trawl mesh-size or gear-type restrictions are very enforceable as long as the regulations are understandable; but when restrictions vary by area and vessels are allowed to carry less restrictive gear on board while in a restricted area, enforcement becomes complicated. A better approach would be to totally prohibit the illegal gear. This would allow dockside enforcement instead of requiring all enforcement to be at sea.

Size, sex and prohibited species retention restrictions should be effective throughout the fishing area. This allows for dockside inspection and provides much less incentive to land under-sized and prohibited catch.

Facilitation of enforcement regulations are not effort restrictions in themselves. They do provide a standard procedure enabling enforcement officers to safely do the job and fishing vessels to properly comply when an enforcement vessel comes alongside.

CONCLUSIONS

Effort restrictions can be effective measures for fisheries enforcement. They can also be very expensive. They are more direct than quota enforcement and simplify enforcement when properly applied. Managers must carefully evaluate effort restrictions for their costs versus benefits to insure efficient regulations. When used this way they become outstanding management measures.

REFERENCES

FLEPM II: A planning model for evaluating alternative enforcement strategies. Alexandria, Virginia, 1980 Santa Fe Corporation

Hayes, R.M. and J.J. Murray, Application of a satellite-tracked fishing vessel transmit terminal to fisheries management and science. NAFO Sci.Counc.Stud., (4):77-83

Joers, A.W., International regulation of marine fisheries. London, Fishing News (Books) Ltd. 1973

U.S. Coast Guard, Study of Coast Guard enforcement of 200-mile Fishery Conservation Zone. 1976 Washington, D.C., US Coast Guard

ENFORCEMENT OF FOREIGN FISHING QUOTA ALLOCATIONS BY THE UNITED STATES COAST GUARD

by

L.N. Schowengerdt, Jr.
Operational Law Enforcement Division
US Coast Guard Headquarters
Washington, D.C.
USA

HISTORY AND POLICY

It is said that no fisheries have a longer history of international exploitation than the high seas fisheries of the Northwest Atlantic.

Despite international exploitation, the US had only entered into three international fisheries agreements by 1945. They restricted the catch of halibut, fur seals and whales, and are still in effect. The main effort by the US to reach conservation agreements began in 1949 with the signing of the International Convention for the Northwest Atlantic Fisheries (ICNAF) which attempted to regulate fisheries in the Atlantic, eventually through quota allocations, and in 1952 with the signing of the International Convention for the High Seas Fisheries of the North Pacific Ocean (INPFC). The ICNAF Convention was in place when the major fishing build-up off the US coast by large foreign fishing fleets came in the early 1960s. The result of the effort was the devastation of many stocks due to the failure of the Convention mechanism to effectively regulate and enforce quota allocations.

In April 1976, Congress yielded to pressure from scientists, commercial fishermen and the public. It passed the "Fisheries Conservation and Management Act" (MFCMA) which established management authority over marine resources in US coastal waters out to 200 miles. The limited measures of international flag State enforcement, provided for by ICNAF, the INPFC and other treaties were abruptly replaced by a management scheme which required vigorous enforcement by the Coast Guard and the National Marine Fisheries Service (NMFS).

Before 1976 boardings of foreign fishing vessels depended mostly on cooperation and on limited jurisdiction over some fisheries regulated by agreements. In some cases boarding could be undertaken only with the permission of the foreign fishing vessel's master. Since 1976, boarding and inspection of foreign fishing vessels within 200 nautical miles has been by right.

In the first six months after passage of the MFCMA, foreign fishing vessel presence in American waters decreased from an average of 715 vessels a month to 471 vessels. The decrease is approximately 25 percent. In 1982 the average number of foreign fishing vessels was around 280 per month. Catch went from approximately two million tonnes in 1977 to an average of one and a half million tonnes through 1982. In 1977 depletion of many species of fish stocks was imminent. Today, most US fish stocks are recovering from over-exploitation.

FISHERY MANAGEMENT PLANS

By January of 1982, as a result of the MFCMA, there were 25 federal fishery management plans (FMP) in effect, 7 relating solely to foreign fishing, and 18 governing both domestic and foreign fishing. Approximately 65 such plans governing foreign and domestic fishing may be in effect within the next 2-5 years. Regulation of a fishery may only be imposed through an FMP. The plan describes the fishery, sets total allowable catches and prescribes regulatory measures to ensure the achievement of the plan's goals. Quota allocations as regulatory measures are implemented when fish stocks can only support a limited amount of fishing pressure and still maintain themselves. The limits on catch change depending on the estimated strength of the stocks.

The MFCMA requires strict accountability for quotas. Each nation is assigned an allocation in roundweight for each species as "directed species" or "incidental species"; "directed species" means a fishery conducted for the purpose of catching that species, "incidental species" means fish of any species other than directed species which are caught during a directed fishery. Permit fees and poundage fees are assessed for the amount of fish caught; incidental catch being generally more expensive per pound than the directed species. Under such a system there is a great incentive to under-report catches. First, since foreign fishing vessels can be prohibited from fishing once their national allocations are reached, particularly those of incidental catch, the master may try to under-report when his allocations diminish. In addition, since these incidental species may be very valuable, there is a greater propensity to underlog the small quota, "high-value" species and over-report the other. A proper comparison of logbooks to catch on-board is essential to establish these violations.

In January of 1983, a review of US fishery management plans in effect revealed six methods to regulate fisheries which are aimed at controlling fishing pressure. These can be separated into two groups: those regulating catch or "quotas" and those regulating "effort". Sometimes both approaches are combined.

Quotas :

a. Catch is limited annually, periodically, by trip or by area

b. Size/sex restrictions - certain fish due to size or sex must be returned to the sea

c. Prohibited species retention - certain species must be discarded

Effort :

a. Closures - some areas are closed to fishing or to fishing for certain species or to fishing with certain gear

b. Seasons - certain species can only be caught during certain periods

c. Licensing - the number of permits issued is restricted

Each fishery management plan requires its own enforcement scheme. Management plans, no matter how well-conceived or scientifically justified, cannot achieve the intended conservation objectives without a vigorous enforcement effort which includes a comprehensive patrol, boarding and inspection programme, and judicious collection of catch and effort data. The Coast Guard and the National Marine Fisheries Service (NMFS) are jointly responsible for enforcement of the Act (FMCA). The fishery management and marine biology expertise of NMFS, combined with the general law enforcement and maritime operational capabilities of the Coast Guard, provide the key enforcement element which has made the Act's conservation programme successful where previous conservation regimes have failed.

In order to help the NMFS scientists to ascertain the status of the fisheries, the figures reported to the US from fishing logs of foreign and domestic vessels must be accurate. This is the primary goal in enforcing quota allocations. The remaining sections demonstrate how the Coast Guard determines the amount of fishery product on board to compare it to the weight logged by the foreign fishing vessel. (The logs for domestic vessels are different.) The discussion is limited to restricting catch by quotas.

ASSESSING CATCH ON BOARD

Since quota allocations are in round weight, our first objective is to determine the amount of fish caught by a vessel. This is a three-part task. First, this involves estimating the number of frozen fish blocks in the holds of the vessel. Second, the boarding party determines an average block weight. Lastly, the catch which was not frozen whole has to be converted to round weight so as to determine the actual weight of all the catch when it was caught. This permits the boarding party then to compare the catch to the master's logs.

HOLD CAPACITY

Taking a count block by block in most situations would take days. Many reasons such as weather, limited cargo handling room, time and hazards preclude such an enterprise. So unless a serious violation is suspected boarding parties will estimate the catch in the hold.

This task is done by measuring the length, width and breadth in terms of blocks or metres depending on whichever is easiest. When using metres the boarding officer will then compare his figures to those in the ship's plans. When using blocks, the boarding officer if necessary will determine the average block size and convert his estimated block dimensions into metres so as to compare his estimate to the ship's plans. Regardless of whether blocks or metres are used as a standard, the boarding officer will compare his estimate to the one provided by the master. Both the block and the metre methods are discussed in greater detail below.

The block method measures the length, depth and breadth of each hold using blocks as the measuring device. Multiplying these numbers results in block volume. For instance, a boarding party may find the hold to have 30 boxes across, 60 boxes in length, and 15 boxes for depth. The result is 27,000 boxes; but, unfortunately, holds are rarely rectangular or square. Thus the above computations require modification.

For instance, holds are frequently oddly shaped due to the shear of the hull. In the case of a hold which has a different width at the bottom than at the top, the simplest solution is to average the two - e.g., 31 blocks across the top and 29 blocks across the bottom. The average is 30.

Another problem in this estimating process is determining the void spaces. Generally the easiest approach is to calculate the void space in terms of blocks and deduct that number from the total hold count. In our example we estimate these spaces to take up to 100 blocks.

For stanchions and other space restricters, the boarding party also must make an equivalent block estimate. In this hypothetical case we can assume 10 stanchions which take up 3 blocks each. Therefore, we deduct 100 blocks for void spaces and 30 blocks for space reducers. We have 26,870 blocks in the hold.

There are situations where a block count is not possible or not reliable. Therefore, a second approach involving a volumetric analysis becomes necessary. This second methodology involves determining the hold volume by measuring the actual length, width and depth. Sometimes these measurements cannot be accurately assessed when the hold is full. Again the master generally knows his hold capacity and his statements can be supported by a design of the ship or other official documents. Void spaces, stanchions, and other unused space also need to be calculated and deducted. Lastly, a certain percentage (generally 2 percent) needs to be deducted from the overall volume due to gaps between boxes.

In our example we have determined from the ship's plans that the hold is 29 m wide, 100 m long and 10 m deep. By multiplying these figures we determine the hold size to be 29,000 cubic metres. We deduct 130 cubic metres for void spaces and 2 percent for gaps. We end up with approximately 28,200 cubic metres.

Once having determined the volume of the hold, the average volume of a block is calculated. The average has frequently been one cubic metre. So, in this situation, the boarding officers conclude there are 28,200 blocks.

AVERAGE BLOCK WEIGHT

The second step in this process is to determine the average weight per block. A random sampling of 15-20 blocks are weighed which in turn are added, then divided, by the number of the sampling blocks to arrive at an average block weight. The boarding officers choose samples from as diverse an area as possible. At least 20 blocks of each type of fish caught are weighed using a set of government scales that have been tested prior to boarding. These scales additionally should be tested against the foreign fishing vessel's scales for any gross errors. In our hypothetical case the average block weight is 22 kg.

In the computation of the average block such things as packaging and water weight must also be calculated. As a general practice not more than 5 percent of the block weight should be deducted. Thus, in our example, we can reduce our average block weight from 22 kg to 20 kg by subtracting 1 kg as water weight and 1 kg for packaging.

The number of blocks in one hold are multiplied by the average block weight. Taking 20 kg times 23,200 blocks we have 46,400 kg or 46.4 tonnes.

PRODUCT RECOVERY RATIO

Whether the block or volumetric analysis is used, we have to convert the 46.4 tonnes of processed fish to the actual round weight of the fish when it was caught to compare it with required logs and reports. In order to do this we use what is called the product recovery rate (PRR). In simple terms, if a fish weighs 1 kg when processed but 2 kg when caught, we say the product recovery is 50 percent. PRR is defined as product weight divided by round weight expressed as a percentage. In our example 46.4 tonnes of processed fish with a PRR of 70 percent tell us that 66 tonnes of fish were caught.

The percentage ratio is dependent upon many factors. The type and size of fish, the processing method (fillets, meal, whole, headed and gutted), the season of the year and catch composition are all factors to be taken into account. In the surimi fisheries, additives must also be accounted for.

The boarding party generally uses a PRR developed by the NMFS. The fishing vessel determines its own or uses one provided by the foreign fishing vessels' fleet command. In the case of controversy, the PRR can be determined by observing a haul-back and weighing a sampling of fish before and after processing. Determining PRR by observing the processing of a single haul-back does not necessarily provide a definitive answer for all fish on board but, depending on the fishery, will at least solve the dispute.

The boarding officer so far has assessed the capacity of holds in terms of fish frozen whole, or after being headed and gutted, or filleted or converted to some other product. The inspection is complicated when it becomes necessary to assess fish that are processed into fish meal. Fish meal is the product of cooking and drying out the undesirable fish and fish parts. These undesirable fish include fish too small for processing, fish torn up by the fishing gear and fish caught as incidental to the main catch but not otherwise used. Generally, fish meal weighs only 10 percent of the original weight of the product - i.e., 20,000 kg of fish will weigh 2,000 kg of fish meal.

The boarding party will determine the amount of fish meal aboard through a volumetric analysis. If 2,000 kg are aboard, then we may assume this represents 20,000 kg of a combination of whole fish and fish parts. From here it becomes a matter of elimination. If we determine there is 60,000 kg of one species of fish in the hold which had a PRR of 60 percent, when we may assume that there was 40,000 kg of by-product which, once converted to fish meal, will weigh 4,000 kg. Obviously, accounting for the fish meal requires reviewing the logs carefully and ascertaining the catch on board accurately. Any type of violation involving fish meal will be very difficult to support due to the very nature of the product.

PROBLEMS

The boarding party, carrying a notebook and pencil, calculator, 50 kg spring scales, 25 m tape measures, and warm clothing can effectively assess the catch on board. However, it is not uncommon to encounter problems as discussed below.

For instance:

a. The Coast Guard's scales and Master's scales do not agree.

b. Hold capacity determined by the boarding officer and the fishing master is false, due to unreported and unobservable void space.

c. The PRR assessed by the Coast Guard and the Master are significantly different.

When serious problems cannot be solved, the Coast Guard may require the Master to take his ship into port where an actual inventory can be taken. This solution can prove very costly to everyone and should be avoided whenever possible.

The taking of an inventory at sea cannot be as accurate as one taken ashore and so the boarding party frequently has to rely on some fundamental assumptions. Sometimes the boarding officer must assume that certain holds contain only certain processed species. It is impossible to locate 5 blocks containing frozen lobster (a prohibited species) among 30,000 blocks without removing all of the blocks.

The boarding party must use its discretion. Generally, the degree of inspection depends on the smoothness of the ship's operation. A ship that has been in compliance with the regulations for several years and whose operations are professional will probably receive a shorter inspection. A vessel which an observer or outside source reports as violating the law may be required to move some of her frozen blocks to another hold so that a more thorough inspection can be made.

Where difficulties exist in identifying types of fish, either processed or whole, the boarding party consults a fish guide-book or turns to the Master for assistance. In additon, if a NMFS observer is assigned to the fishing vessel, his or her expertise can be very useful in identifying fish. The boarding officers must be alert for fish that is incorrectly labelled, especially in the case of small quota species in mixed fisheries.

LOG-KEEPING

Under the MFCMA, foreign fishing vessels are required to maintain logs and make periodic reports to the NMFS. The required logs include a Daily Cumulative Catch Log (DCCL), a Communications Log, and a Transfer Log. Logs are required to be kept in English except the transfer log. The required reports include a Weekly Catch Report, a Weekly Report of Receipts of US Harvested Catch, and a Weekly Report of Marine Mammal Incidental Catch. Additionally, most fisheries use the following logs: Navigation Log, Fishing Log, Processing Log and Reefer Log. There are three objectives in reviewing these logs and reports: to check for consistency between logs, to check for consistency between logs and reports, and to check for consistency between logs and actual catch.

LOGS

For the purpose of enforcing quota regulations, we are concerned with the logs described below:

(1) **Daily Cumulative Catch Log (DCCL):** This is the most important log and is thoroughly checked for internal accuracy. The DCCL must record the total catch the vessel has taken in all areas during the year. This means that the product off-loaded in the ship's homeport or elsewhere, the product transferred to other vessels, the product discarded, and the product on board should equal the total in the DCCL. This total is expressed in round weight. If all the product off-loaded or discarded is subtracted from the DCCL total, the boarding officer can determine the total on board. The log must include the following information:

a) Fishing area
b) Date of catch (GMT)
c) Amount caught in whole weight before processing
d) Disposition of catch: human consumption, fish meal, discard
e) Cumulative catch for each species for the year
f) Prohibited species caught

(2) **Transfer Log :** This log records information on transfers of fishery products to any other vessel. The only means of verifying the contents is to check with the vessel receiving the transfer. The US does not currently require prior notification of a transfer, but the Coast Guard makes every attempt to observe transfers. The log must include the following information:

a) Date, time and position of transfer
b) Name, species code and amount of each product transferred
c) The vessel to which the transfer was made

REPORTS

Reports are reviewed mainly to check for uniformity with the DCCL Log. These reports are required for each nation, for each vessel, on a weekly basis - Sunday through Saturday GMT, and record each week's activity.

(1) **Weekly Catch Report :** This report contains the catch information from the DCCL for the appropriate week. It also includes catch of prohibited species.

(2) **Weekly Report of Receipts US Harvested Catch :** This report is similar to the Weekly Catch Report and is required for vessels engaged in joint ventures. Joint venture permits normally require foreign vessels to fill out NMFS supplied forms similar to a DCCL for fish received from US vessels.

(3) **Weekly Report of Marine Mammal Incidental Catch :** This report gives the position, species, number and condition of marine mammals caught incidental to fishing.

OTHER LOGS AND REPORTS

There are other logs and reports which can be used to detect potential violations. Standard marine practice and flag State requirements require logs and reports which can be used to verify required information and determine hold contents. Any log, record or other document is subject to inspection under the US Law, whether or not it is a required record.

(1) **Navigation Logs :** Are generally similar in form and content to Coast Guard ship's logs and man contain useful information on:

a) Positions at specific times
b) Activity of the vessel (i.e., trawling, transferring, transiting)
c) Identification of other vessels in transfer operations
d) Daily production

(2) **Trawl or Fishing Logs :** Are kept by almost all vessels and are the second most important source of information for our purposes, and should be carefully cross-checked with the DCCL. Information includes:

a) Time and position of setting and hauling each trawl or set
b) Catch by species and amount
c) Verification of activity
d) Water depth and sometimes temperature to verify position and pelagic/bottom trawling
e) Transfer information

(3) **Processing Logs :** Processing logs come in many forms, from scraps of paper to bound ledgers. They frequently consist of a running tally of product that is flash-frozen and stowed in the hold. Species may or may not be identified and transfers may or may not be taken into account. Many crews are reluctant to admit having a processing log, although economic considerations and transfer requirements would seem to indicate a strong need for this information. When the log is found, the amount of fish caught can be determined by:

a) Determining average frozen block weight for each species/product
b) Deducting not more than 5 percent of total weight for water and average weight of packaging
c) Multiplying the revised block weight by the number of blocks of each species products for product weight.

(4) **Reefer Logs :** Reefer logs are engineering logs, similar to Coast Guard engineering logs. They list equipment running times and dates run. Determining how often the fish freezers are run and their capacity can give a close approximation of the amount of product on board. A running block count may also appear in the logs.

PROBLEMS

The above logs and records are individually important to the boarding party. If the boarding party is checking to see that the catch has been properly recorded, it will generally inspect the DCCL and trawl logs very carefully. If the boarding party is checking to ensure that the vessel has properly reported its catch, it will inspect the weekly catch report and communications logs and compare these to the DCCL and trawl logs. If the boarding party suspects any type of violation it will attempt to locate the ship's processing logs so as to compare them with the DCCL, trawl logs, weekly catch report and the actual catch on board as estimated by the boarding party. If an NMFS Observer is assigned to the fishing vessel, he or she will generally assist the boarding party in the above.

Obvious violations, including failure to record incidental catch, failure to convert processed fish to found weight or failure to maintain logs occur less frequently. Violations have become more complex in recent years. Even though the ship's logs may reflect the boarding party's assessed catch, this is not conclusive that the ship is not under-logging. The following are two hypothetical examples which have similarities to recent violations.

(1) **Under-logging :** Certain species are more valuable either because of the poundage fee or because the country has used almost all of its allocation. For instance, during a routine boarding, the Master of a vessel claimed to have caught 5 tonnes of species, "X", within the past 24 hours. The Master had not yet recorded this catch (DCCL is only required to be current within 24 hours). The boarding party had four reasons to suspect the ship was intentionally under-logging.

First, it knew that such a large catch of "X" was unlikely in one day. This suspicion was verified by calling other fishing vessels in the vicinity and comparing catches. No vessel had caught more than 1 tonne of "X" within the last 24 hours. Second, the country's allocation of this species had almost been reached. Vessels from that country would no longer be able to fish once having caught their allocation. Therefore there was a motive to under-log. Third, the processing plant showed no signs of having processed "X" within at least 4-6 hours. Lastly, species "X" is only supposed to be caught as incidental catch. The poundage fee for incidental catch is generally higher than the poundage fee for directed fisheries. The vessel was found to have grossly under-logged.

(2) **Species Manipulation :** This involves consistently under-logging one species and over-logging another species. For instance, a vessel claimed to have caught 20 tonnes of "W", 30 tonnes of "X", 40 tonnes of "Y", and 50 tonnes of "Z". There was 140 tonnes aboard. The boarding party had three reasons to believe the ship was under-logging species "W" and "X", and over-logging species "Y" and "Z". First, it found that species "W" was being stored and dispersed randomly. Second, the Master was using a PRR which the boarding officer believed to be too high for "W" and "X". Third, the boarding party found the unit production log which was being kept by the first mate. Since the production log was kept by block count, the boarding party had to convert the blocks into the weight of the actual weight. The unit production was found to be significantly different than the DCCL. In summary, the vessel had actually caught 30 tonnes of "W", 40 tonnes of "X", 30 tonnes of "Y" and 40 tonnes of "Z", and was seized for species manipulation.

CONCLUSION

The enforcement of quota regulations at sea can be effective. A system of logs and records and well-trained boarding officers is required. As boarding officers become more proficient, violations will become more complex as sophisticated methods for cheating develop. Mixed fisheries quota systems are more difficult to successfully regulate than single species and those with low by-catch.

FISHERIES MANAGEMENT IN ALASKA

by

Clement V. Tillion
North Pacific Fishery Management Council
Anchorage, Alaska 9951
USA

As one who spent much of his lifetime as a commercial fisherman, I understand the hatred of any kind of regulation (I feel the same way myself) but, as I moved into part-time research on king crab and shrimp and then salmon negotiations, followed shortly by eighteen years of politics in the State legislature with a steady emphasis on fishery management, I began to look at the way the United States managed the fisheries under its jurisdiction and came to the conclusion that; with a few notable exceptions, we were managing our fisheries the same way that the Soviets managed their agriculture and, I might add, with the same results.

The United States imports no less than 50 percent of the fish the US citizen eats and some years we import up to 70 percent - this for a nation that has 20 percent of all the living resources of the northern hemisphere within its fisheries conservation zone.

Freedom of the seas to many is the right to plunder; what we see is the tragedy of the commons of Old England; proof to the adage, "that which we own we care for; that which belongs to our neighbour or to mankind as a whole we use and abuse"; has there ever been a common pasture that did not have more cattle on it than it could sustain?

What good land-owning farmer would allow his herd to exceed what his land would feed unless he had access to the commons, in which case he would plunder then knowing, in many cases, that he was going irreparable damage but using the excuse that if the did not do it another would? No one could refute the logic but can the world stand by and laud it as a basic freedom? Or is now the time to look at a fishery not as a means of employment or a life experience but as a way of producing food for a hungry world?

There are some who still remember Alaska as the last frontier: free land, little law, an endless supply of fish and meat for the taking; well, its over. I will never forget what it felt like to stand on a hill and look at a land that looked like it went on forever; but I also remember what it meant to have the last ship leave in October - the next one came in April. Few roads, few doctors; what it feels like to have someone sick or hurt and no one to call to; so, for me, the good old days were a mixed blessing. We still have a small population but it is five times larger than it was at the end of World War II: when I need a doctor I pick up the phone; when I want light, I no longer trim the wick and fill the bowl, I just flick the switch and we have light; and you know, I like it.

Not that I do not shed a tear for the days when the streams were full of fish and no road brought people from town. Now the season is short and on opening day people stand shoulder to shoulder to fish, and that brings me to the subject of management; we have some fish left in our streams and bays but to keep them strong we have all had to give up some freedoms.

For those of us in management we have had to say "No, we cannot kill that moose, or deer, or wolf, or salmon, or cod," so that our grandsons may have some too; but even worse in the case of something that has become a cause celebré is to say yes: yes to a hunting season to thin 500 wolves out of an area to let moose survive; or yes to harvesting young seals, however cute they are. To manage an ecosystem you must figure that those who live must eat and, like a Swiss banker's creed - protect the principle and live on the interest - must be our motto.

When I sit as a US Commissioner to the North Pacific Fur Seal Treaty, I am fully aware that it takes six million pounds of fish a month to feed them, and that is a million tons a year. In my mind I also see the hungry people and, while I would not give one inch of the conservation ethic for them, neither would I turn them away while I have plenty.

I used to be on the cutting edge of the conservation movement. Now those who claim to be the leaders prepare television programmes; often, I might add, with little regard for the truth, to protect pet species while I am still asking "How many alligators can the swamp hold without endangering something else?" Whales! What species are we talking about? Is it not a little hypocritical to condone the taking of an endangered species by a primitive race that needs it for food while raising a great fuss over the harvest of a species that is at an all-time high only because it is a highly-industrialized nation taking them?

It was this very line of thought that led me to the position of lobbying for the passage of the present law extending our jurisdiction unilaterally out to 200 miles.

Looking back in history I see the oil industry in its early years from Pennsylvania to Texas boom and bust. If one hit oil, everyone who could scrape together enough for a rig rushed to see if anyone with enough land to set a rig on would sell or lease a site so they could drill into the formation. The one who hit the pool pumped as fast as possible to get as much as possible before his competition got there.

There was no regard or knowledge for natural flow, with a result that in most cases 80 percent of the oil was never recovered, and in most cases the cost of production came close to the value of the oil itself. Then came the Texas Railroad Commission - some freedom lost but a lot more oil recovered. Primitive, yes, but a simple "If you do not have such and such an amount of acreage under ownership or lease, you cannot drill a well". Gone was many a small outfit but generations of my countrymen grew up with cheap oil. The consumer got a break - misused, perhaps, but nevertheless until we felt obligated to subsidize instead of charging full value, he received a real break.

When I was a young man, the cowboys who had seen the open range and the great cattle herds were still alive, still singing songs about not fencing them in. The fact that their reckless use of the land was rapidly turning a vast piece of North America into a desert did not bother them. Some saw, but most had grown up watching or at least hearing the news of the Indian wars and the opening of the west. To them a fence was the restriction of their freedom.

When I was a young man impatiently waiting for my seventeenth birthday so I could join up and go to war, I doubled my fist and argued with an old veteran of the frist world war. My father (as I doubled my fist and raised my voice) looked at me kindly, I now believe, and said "Go ahead and say whatever you wish, Clem; just keep in mind when you double your fist that all your rights end where my nose begins". The cowboy at the turn of the last centry did not seem to see that his fist not only could reach his neighour's nose but that there was a very real danger that he might take his neighbour's head right off.

Then came the Taylor Grazing Act to regulate the use of the commons. In concept it was simple: freeze the number of ranchers using the land, give them each the right to run that percent of total number of animals they were running at the time that the bill passed, and then reduce the number to an amount the range could feed. It was not accepted with ease but, into the minds of a few ranchers, the glimmer of light took hold. If rancher "A" had a set percent of the whole and he could get together with the other ranchers and reduce their herds well below the government requirements, thus reducing the need to buy as much supplementary feed, no one could move in on him. It cost very little to raise the beef. He did not need as many cowboys but he could still produce cheap beef, and several generations of Americans grew strong on meat a working man could afford.

As a young fisherman I knew about aquaculture but thought it was only done in a pond; true they did have oyster farms, but it did not really register until I read about the alewives run on the Penobscot in Maine. Since colonial times the county had owned the river and rented the right to harvest on an annual basis; eventually the run was down to so little they had no bidders. As I remember it, one company offered to lease if they could have it for forty years.

With stream improvement they brought it back to levels never seen by anyone then alive. True it can all be lost with pollution upstream, but the idea began to take hold and, as a young legislator, I supported the idea of limited entry in the inshore fishery of the then-new State of Alaska. Mine was not an original thought: others had brought the subject up but, for the support of Alaska's first Governor, William Egan, it would never have passed.

Lest I leave the impression that Alaska was a leader in North America, I must say here that Canada was the real leader but we were the first in the United States. Canada led Alaska by four years and, without Canada as an example, I doubt if we could have succeeded in passing the bill through both houses of the Alaska State legislature.

When looking at a system, too many people look only at the faults, not at what it would have been like if no one had done anything. For the US fishermen, just doing business as usual meant the managers trying to save the fish through gear restrictions and time limitations, while dividing the catch among an ever-growing number of fishermen: the battle was looking ever more hopeless.

When the Canadians reduced their fleet and made a property right of a fishing permit, they changed a fleet of rickety old boats owned and crewed by those left over from better days into a different kind of competitor for my country. With a Canadian salmon permit a man could go to the bank and have collateral for a boat loan. Younger men could see a future in the industry; in four short years the average age of the Canadian fisherman went down twenty years as young men bought in, modernized the fleet, and went from 40 percent of the troll salmon catch to 60 percent of the Pacific salmon catch. With their home fishing grounds secure and with modern boats to work, they used their off-seasons at home to hit the salmon stocks seaward of the US 3-mile limit.

The story became the same for halibut. The American fisherman stood in shock. Some, like the Washington State men, turned to their congress. Others, like Alaska, while supporting Magnuson's efforts to extend fisheries jurisdiction unilaterally to 200 miles, went to work on their own version of limited entry. Extending jurisdiction was a simplistic solution that brought the living resources under management control and from that standpoint I supported it; for, like a ship that operates best with a captain and not a committee, the more fragmented the management responsibility the more difficult the job.

Extended jurisdiction is a tool - if used by itself it will at best only postpone the failure, the living resource can only take so much pressure and, whether it comes from the mobile fleets of the world or from a single province, it is at best only a matter of time, so I would like to say to those in management "Are you going to be satisfied with a quick fix? Do you like to move only when crisis moves the body politic? Or are you looking for a long range solution?" I know that for some there is little choice, for politics is the art of the possible and the real solutions take time.

First the resource must be saved. This in itself can seem like an insurmountable problem when many people depend on the daily use of a resource, but if you do not take this step, the rest of what I have said means little.

When the management biologist says it requires a 25 percent or 75 percent reduction in take, or maybe a 5, 10 or 15-year ban on any harvest, he can expect little help. Those in politics will often say "Could we not get by with only a 10 percent cut?" The answer is yes. With a small cut the resource will die so slowly that with luck the people might never notice. On the other side, at great political cost, the cuts might be made only to have nature do you in the eye!

In the 1960s our Bering Sea salmon fishermen were asked to take massive cuts. Native people stood on the banks of rivers in Bristol Bay and watched their only source of income swim by while troopers watched to see that no one bought illegal fish, and then in 1972-73, the fish came rolling in; one of the largest runs ever seen. The 1973 run was the seventh largest in recorded salmon history.

The future looked bright. Then came a dry, cold winter, water levels dropped and sand bars where salmon had spawned went dry in 40 below zero weather. Eighty percent of the spawn died but all was not lost; the 20 percent survived and then next year, a late spring, the young salmon headed downstream for the sea only to find it still frozen. The seventh largest run in Alaska history was a total loss.

Back to the people, more cuts, more lean years; then in 1980 it all came together and for the last three years record runs - runs that rival anything since we bought Alaska from Russia in 1867. Biologically we can be proud. We had seen a problem and solved it; or had we? The population had grown, the quality had not improved and so we had again failed to look far enough ahead.

Regulations had been made with only short-term goals in mind. Fish and shellfish can be managed with only biology in mind and be extremely successful but fail sociologically. So now I would like to place some questions as well as recommend solutions or explain what we have done and/or want to do.

The question is: "What do you want from your resource?"

1. A quality product at a reasonable cost? (my choice)
2. As limited a number of fishermen as necessary to make a good living on a full-time basis?
3. Unlimited fishermen fishing often for a subsistence income but with little restriction?
4. A highly mobile fleet pulse fishing to take the best of each species and move on to the next along the coast?

All of the above can be done within the biological limits of good management.

In most cases the decision of what kind of fishery you want has been made by those with narrow or short-term views. While I criticize the politicians for their approach to biology, I now criticize the biologist for trying to make political decisions, for how the biological pie is cut is, and should be, a political decision. A wise politician will let the biologist bake the pie but never let him cut it.

For example, there is a crab fishery that allows only males of over a fixed size to be harvested. Traps are used that require an escape ring of such a size that small males and females can escape (good biology) but to make doubly sure an overall quota is placed on the area involved. This should have been a political decision for without understanding they had also decided what kind of fisherman would harvest the crab.

With an overall quota, the fisherman with a vessel that can fish in any kind of weather, haul huge amounts of gear and travel great distances has such an advantage that the quota is filled in shorter and shorter seasons. The smaller vessel is forced out or into another fishery that might also be marginal for those already in it.

You can say: "That's competition", but it is negative competition in this case. If the season had no quota, only size and sex limitations plus spawning area closures, what do you think it would have looked like? With a long season there would have been a drop in catch per unit of effort; in this case, the number of crabs caught in each trap each day or lift. The smaller vessel with one or two or three crew, often families, could make a living on less crab than a large vessel needs to pay for fuel and expenses. True, they would have days they could not fish, but the gear would not be out and the season long enough so they could affort to wait.

How does this affect the price? If the crab were caught in a short season the product must be held, canned or frozen, for market - often for months.

In Alaska, king crab can spend eight months in the freezer (cold storage). As 90 days is about maximum for quality, much of the year the consumer has only a second or third rate product to choose from. Now add to this the cost to the packer and you have a product of lower quality that costs the consumer more for storage and interest than the fisherman got for what should have been a quality product. A king crab packer talking to me about this said that before the quota he had 60 employees, mostly local, working year-round and by the time the season quota was filled in under two months he needed 300 workers for two months' work, most of them migrant workers from 2,000 or more miles away, and for the local people the season was too short to make a living.

A system like crab or any species where only excess males are harvested is much easier to manage than those like the mixed-stock groundfish that take both sexes and often mixed age groups. There are found selective types of gear, seasons, closed areas where no fishing takes place, exclusive registration, areas where only certain types of gear may be used, and a vessel may fish only one area. It all comes down to the need for some form of limited entry or each area will have more vessels, men and gear than the area can support in any but the best of years.

The longer the decision to institute a limitation, the less likely it is to work without great hardship. The sad part is that politically it is often difficult to move without a disaster for impetus.

Another decision that must be made is: do you want a major part of the target species to be processed ashore or aboard a catcher-processor? The catcher-processor must have room to move to pulse fish over a large area. The plus side of this is that the fish are processed as they come aboard - quality at its best - and it also allows the exploitation of areas distant to good shipping and harbour facilities. The down side is that the operating costs are 15 percent higher and long-term workers are hard to keep, so again, just saving the fish will not in itself bring the desired results.

In Alaska, during territorial days when the fishery was managed from Washington D.C., the coast was cut up into smaller districts to discourage pulse fishing.

Before I go too far here, I should point out that Alaska has 32,000 miles of coast, or 50 percent of the total United States coastline, and 60 percent of the United States continental shelf, so most of the fishing areas I speak of are still as large as many a nation.

After statehood, when a fishery management became a state responsibility, the areas were still kept, but the fleet in most areas had grown to the point that a management error of a few hours could cause great biological damage; and with the then high price of salmon, new gear arrived every year.

For many areas salmon limited entry came late but at least it put a lid on. In Alaska, salmon and herring limited entry permits are the property of the fisherman; they may be sold but not leased. The person owning the permit must be on the vessel both fishing and delivering the catch. The law provides for an assessment against the fleet of each area to provide funds to buy permits as a method of reducing the fleet in areas of too much gear, but to this date no buy-back has taken place.

In those areas where the fleet is not too large, the private property concept has made major changes. Fishermen are banding together to build their own salmon hatcheries. Last year, in the Prince William Sound area, a fishermen-owned-and-operated facility harvested eight million returning pink salmon. With a vested interest, fishermen tend not only to accept restrictions but, in some areas, have asked for even more conservative management, and not least is the advantage to law enforcement. No longer is the man who breaks the law and violates regulations accepted by the other fishermen as one who is just stealing from the government. 'Now it is his brother's fish'

In Alaska, we finance our management and enforcement vessels through a raw fish tax on all species landed. If I could be in that position of writing law again, I would recommend a percentage of all fish landed under a limited entry fishery on the same basis as oil drilling permits as a way to show the general public that those who have the right to harvest a public resource pay a fair rent.

Not that it need be as high a share as oil pays for. Unlike oil, fish can be forever, i.e. a renewable resource, and many an Alaskan salmon fisherman has found that, if management is good and fish stocks increase, so does the value of his permit.

When the United States Congress passed the Magnuson Fishery Conservation and Management Act extending United States' jurisdiction, it had major impacts not only on other nations but on those US States landward of the 197-mile wide fishery zone.

The Congress made eight regional councils. Some will work better than others but, as I have stressed, conformity is not vital. The North Pacific Council, of which I am Chairman, is made up of eleven voting members and includes the Regional Director of the National Marine Fisheries Service in Alaska (an employee of the US Department of Commerce), the Commissioner of Fish and Game (Alaska) and, because so many fishermen from the States of Washington and Oregon fish in Alaskan

waters, the commissioners of the fisheries of those two States. The appointments are made by the Secretary of Commerce, taken from a list of six names from the Governor of Washington, from which two appointments are chosen, and a list of fifteen names submitted by the Governor of Alaska, from which five appointments are chosen. The members serve staggered terms. In the case of the North Pacific Fishery Management Council, all but one of the non-government appointments were made from advisors or commissioners to the International North Pacific Fisheries Commission, an international treaty organization of Canada, Japan and the US for the management of the high seas fisheries of concern to these nations.

Those who serve on the Council were not only familiar with the foreign fishery but had formed a great deal of mutual respect for the fisherman of those countries operating distant-water fisheries off the coast of Alaska.

The unlimited fishing had depleted many of the major stocks such as herring and Pacific Ocean perch, and the pollock had dropped in size from 16 fish to make a 20-pound block to 36 fish.

Upon passage of the Act extending jurisdiction and forming the Council, our first job was to bring the production of the North Pacific back to a reasonable level. Cuts were drastic for some species, enforcement strict and court penalties high. Alaskans consider fish and game violations of great importance and State and Federal judges act accordingly. A domestic violation for illegal fishing can result in fines in the hundreds of thousands of dollars, plus jail time and, in some cases, the confiscation of the vessel. While the actual operation of the management councils is clumsy, somewhat bumbling, and often impeded by lack of communication and understanding especially where time frames are concerned with Washington D.C., the fishery resource is recovering.

It is our job to see to it that the United States fishery grows and prospers to the exclusion of other nations that now fish this area. The law is very clear that those resources surplus to the biological needs and the ability of the US industry to process must be made available to other nations as decided by the United States Department of State.

The North Pacific Council works closely with the State Department, with a representative from State at our monthly meetings, not hard to understand when all the fisheries allocations made to other nations within the fishery conservation zone of the United States, 96 percent are made off the coast of Alaska.

Japan, by far the largest fleet, harvests over 160,000 tonnes that Japanese processors buy directly from US fishermen. This tonnage is impressive when compared to Atlantic landings but, when one figures the amount of fish required to feed the massive populations of marine mammals, it can be seen that marine mammals harvest 2.5 pounds of fish for every one pound taken by the fishermen of all nations. Now, while the fishery stocks of the North Pacific are in excellent biological condition, there is little or no surplus fish; and new entry into the fishery, be it US domestic or foreign, will require realignment of allocations. As the increased effort by US industry squeezes foreign allocations, some nations have invested in onshore processing facilities.

Japan now owns 50 percent of the onshore processing plants in Alaska, with sizeable investments in others. Seventy percent of all fishery products caught by US fishermen in Alaska are bound for Japan (80 percent of our timber resource is also bound for Japan).

Alaska looks more to the Orient for the market of resources than to the United States, whose own contiguous waters under good management should produce all her fishery needs.

The North Pacific Fishery Management Council looks with favour on all nations wishing allocations under the Fishery Conservation and Management Act, so long as they also engage in some joint venture activity such as buying raw fish directly over the side from US flag vessels.

The Soviet Union buys 50,000 tons of groundfish a year from US flag fishing vessels and, for this reason, there is strong sentiment in the North Pacific Council favouring a direct allocation to the Soviet Union.

Now, to look ahead, the American fisherman in the North Pacific does not even want to consider any future beyond the displacement of foreign fleets operating off Alaska. The large vessels that form organizations that go by names like "The Coalition for Open Ocean Fisheries", while being the match of any fisherman in the world, have all the winsome benevolence of a band of Vikings bound for the coast of Normandy some ten centuries ago. For the Eskimo and Aleut fisherman off the Alaska coast, they are a terrifying operation, so the North Pacific Council must regulate from the domestic as well as the foreign standpoint. Those species such as halibut, herring and crab have reached what we consider maximum production. The herring, except for 2,000 tons taken incidental to other species, is harvested within State waters by the use of seine or gill-net and, while limited entry is used, it alone does not solve the problem. Last year's open season in Prince William Sound lasted only four hours and still went over what the regional management biologist had set for the area quota. The problem is still the fact that, without some form of limited entry plus area licensing, any rational management system would go from difficult to down-right impossible. While our Alaska system of limited entry works for salmon and herring because the run comes in over a very short period of time, for species such as halibut that are available every month of the year, a system that encourages a harvest in a very short period of time (our halibut season in the North Pacific was $5\frac{1}{2}$ days in one area and 13 days in another) is detrimental to both the stocks and to the consumer, as pointed out earlier with regard to crab.

Toward this end, the North Pacific Management Council is moving; holding public hearings this winter on a moratorium plus a study on a share system similar to that recommended by Dr. Peter Pearse of Canada. That system uses a permit and a quota based on a percent of the total catch attached to the vessel.

If one wishes to use this route I would lean toward allowing all fishermen with proven landings in the past four years to pick their best year, put the total together, and divide by the total weight available for the next year. This way fishermen get X percent of future year's landings. If stocks go up, his fixed percentage amounts to a greater weight; if stocks go down, a lower weight. He can fish at any time of the year, thus being able to watch the market or mesh in with another fishery; make it saleable and taxable like any other property right. If you want an owner-operated fishery, require the owner to be aboard when fishing and delivering. If you do not care, just let anyone own and lease but in the end you will find that the product will come ashore as market demand is at its best.

Smaller vessels with lower operating costs will take a larger percent of the catch and vessels fishing other, lower-priced fish, will buy quota shares and the high-priced fish will become an incidental part of the catch or, as some say, the cream of the milk.

Now, in closing, I wish to again make a point. No system of limited entry is perfect. Some will work well on one species, other systems on another species. Some will work best as part of other regulatory systems like area licensing, time and gear controls; and should be just a tool to get where you want your fishery to be twenty years from now.

FISHERY REGULATIONS ADOPTED FOR COASTAL AND OFFSHORE FISHERIES IN JAPAN
With particular reference to the Fishing Right System

by

Tadashi Yamamoto
College of Economics
Nihon University
Tokyo, Japan

1. INTRODUCTION

The major objective of the present paper is to review the Japanese system for the regulation of coastal fisheries, with special reference to the biological knowledge required for the effective allocation of resources to the communities concerned along the coast. In tackling this subject, however, some difficulties are encountered because Japanese fishery legislation is designed as a single package combining coastal, offshore and distant-water fisheries. There is no measure dealing exclusively with the regulation of fisheries for coastal communities - regulations established for coastal fisheries usually are closely related to those for offshore fisheries. It may be desirable, therefore, before going into detail with reference to fishery regulation specifically for coastal fisheries, briefly to describe the entire system and the historical development of Japanese fishery legislation.

2. GENERAL REVIEW

2.1 Development of the Fishery

The marine fisheries in Japan are composed of: (i) the coastal fishery, (ii) the offshore fishery and (iii) the distant-water fishery. The first two operate mostly in waters adjacent to the Japanese coast, which in general fall within the exclusive economic zone (EEZ) of Japan. Although a precise definition of any of the three fisheries does not exist, the coastal fishery may be considered as the one operating in coastal waters with relatively small fishing craft, i.e. usually those of less than 10 gross tons (GT). This fishery also includes mariculture. The offshore fishery operates in waters farther off shore with larger vessels, usually over 10 GT, and the distant-water fishery operates far beyond the waters around Japan, i.e. on the high seas or in the EEZs of other nations.

The coastal fishery in Japan has a long history, extending as in many other countries over several centuries. It had been developed substantially even when the country was still under the feudal regime. Various types of fishing operations already had been employed during that period, including the manual collection of shellfish and seaweeds as well as the use of hand-lines, long-lines, gill-nets, beach-seines, boat-seines and set-nets (large, barrier-type stationary gear). Most of these types of operation were carried out on an individual basis, with the participation of fishermen's family members. Beach-seines and boat-seines, however, were operated by groups of fishermen under partnership arrangements, i.e. for sharing net ownership. Only the set-net fishery, operated by an entrepreneur who hired many fishermen, was capitalistic in nature during the feudal era. The coastal fishery as thus constituted remained essentially unchanged until about the 1950s. After World War II, the mariculture of several fish species, e.g. yellowtail, red sea-bream and Kurama prawn became an important component of coastal fisheries, being supported by advanced rearing technique and technology. Recently mariculture has played a highly significant role in these fisheries in terms of both the quantity and the commercial value of production.

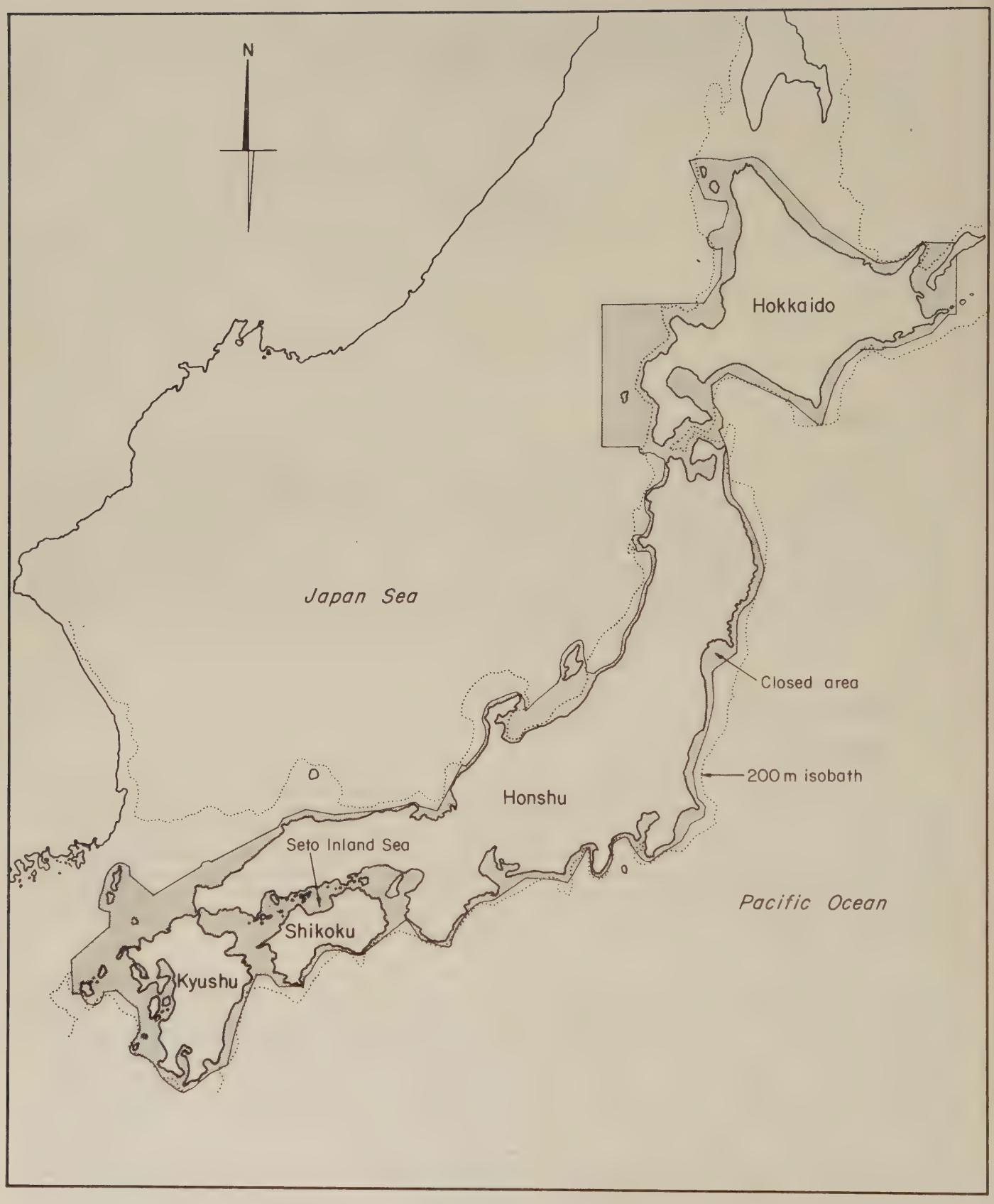


Figure 1. Areas closed to trawling

During the period 1904-08, some otter trawlers of British type were built and trial operations subsequently were carried out in coastal waters around Japan. As serious conflicts arose between these trawlers and coastal fishing craft, however, the government restricted the grounds for the former vessels to the East China Sea. They represented, nevertheless, the forerunner of the Japanese distant-water fishing fleet. Thereafter, trawling with a single vessel, which resembled Danish seining, and pair-trawling were developed by Japanese fishermen themselves and these techniques spread rapidly, i.e. within seven years (1913-20), around the coast of Japan. As a result of renewed conflict between trawlers and coastal fishermen, the government established a system of closed areas for trawling in 1921, the details of which are shown in Figure 1. In the meantime, modernization along other lines emerged, e.g. purse-seining, pole-and-line fishing (for skipjack) and long-lining (for tuna), together with the use of larger craft and more powerful engines. These technologies and that of the aforementioned trawling formed the core structure of the present offshore fishery.

Striking development of the distant-water fishery occurred following World War II, with operations extending to fishing grounds throughout the world. This expansion ceased about the mid-1970s, however, as a result of the extension by many States of fishery jurisdiction over a 200-mile coastal zone.

2.2 Historical Evolvement of Fishery Regulations

Fishery regulations in Japan have evolved in pace with progress in development of the fisheries. The historical changes fall into three stages.

(1) The Feudal Era (to 1900)

Fishery regulations first appeared in the early 1700s as a basis for the collection of royalties/taxes by local feudal lords from farmers and fishermen. For this purpose all coastal villages were defined as being either agricultural or fishing villages. Only dwellers in communities classified as fishing villages were permitted to fish in waters off the shoreline of such villages. Those living in defined agricultural villages were allowed only to remove seaweeds (for fertilizer). Certified fishermen, however, could harvest the waters off neighbouring agricultural villages. On occasion, a lord granted special fishing privaleges to an individual or a group of people who had made a substantial contribution to his government. Such grants often pertained to grounds far from the village where the person or persons lived. In those days, the fishing rights and privaleges bestrowed by feudal lords were recognized as hereditary properties. The feudal era ended in 1869 but the rights established by feudal lords remained in force until 1900.

(2) The Old Fishery Law (1901-48)

In 1901, a law was enacted which in this report is referred to as "the old fishery law". This law legalized all traditional fishery-management arrangements, i.e. all fishing rights and privaleges granted earlier by feudal lords were converted by statute into "exclusive fishing rights". Since these usually specified the area of operation and the species to be caught, however, there remained some room for the issuing of additional exclusive rights. Two types of fishing rights thus came into force: those based on tradition and others newly instituted. Irrespective of their origin, such exclusive rights were classified as (a) those for mobile harvesting gear, e.g. long-lines, gill-nets, etc., (b) those for beach seines, (c) those for set nets and (d) those for mariculture. These rights, in principle, were conferred on the fishery associations organized by the fishermen in each village.

In every case, the fishing ground(s) to which the exclusive right applied was (were) clearly demarcated. During the initial stage, the areas allocated under class (a) rights, i.e. for mobile harvesting operations, were restricted to a comparatively narrow band of coastal waters. When these rights were renewed, about 1935, the areas were extended seaward to include the range of migratory species. Progess in the motorization of fishing craft had made such grounds accessible to coastal fishermen.

Application of the old fishery law, confirming traditional arrangements, gave rise to numerous disputes related to perceived unfairness in fishing opportunity. Due to the fact that the ownership of

rights off one village might belong to another village, fishermen could be forced to pay fees for operating in waters bordering their own community. Conflict consequently tended to occur as between communities rather than individuals.

Development of an offshore fishery, which had taken place during the period of the old fishery law, also resulted in conflict between divergent interests. The most serious instances occurred between coastal fishermen and trawler operators over the effects of trawling on nearshore fishing grounds. Eventually the Ministry of Agriculture and Forestry was led to establish special regulations for the trawl fishery. Excepting a limited number of exceptional cases, all types of trawling, including operations by otter-trawls, pair-trawls and Danish seines, were prohibited in coastal waters. This was the first occasion in Japan that numbers of fishing vessels were restricted by licence; a similar approach was adopted afterwards for other fisheries in turn.

(3) Current Fishery Law (1949 to present)

The 2nd World War ended in August 1945, and Japan was under the control of Allied Forces until April 1952. During this period, a number of measures were taken by government to reform the socio-economic structure of the nation and establish a truly democratic system. A typical such measure was the agricultural land reform. The area that a landlord might own was limited and any acreage in excess of the defined limit was purchased by the government. The farmlands thus acquired by the government were resold to tenant farmers, with the result that tenants without their own land no longer exist in Japan.

A similar measure was applied to the exclusive fishing rights conferred by the old fishery law. All such rights, regardless of their origin in tradition or law, were cancelled. This provided an ideal opportunity for the establishment of a modern system based on principles of equity. The fishing grounds were reallocated among the coastal fishermen who wished to participate in the fisheries. At the same time, the government issued compensatory bonds (cashable in five years) to those who had lost fishing rights through reallocation. The new regime was established under the current fishery law, enacted in 1949, which, among other things, incorporated the licensing approach of the previous legislation without change in principle.

3. FISHERY REGULATIONS CURRENTLY IN EFFECT

As indicated in the preceding section, fishery regulations in Japan constitute a dual system, viz. fishing-rights regulations and fishing-licensing regulations. The former apply principally to the coastal fisheries and the latter to the offshore and distant-water fisheries. The present study is focussed on the regulation of fishing rights but, since some coastal fishermen with larger boats possess licences for the harvest of widely distributed fish stocks, reference may be made also to licensing regulation. For details on the latter, see the comprehensive paper entitled "Licence Limitation Regulations: the Japanese system", prepared by Y. Asada and presented to the FAO Technical Conference on Fishery Management and Development at Vancouver in February 1973.

3.1 The Role of the Fishery Law

Japan is an island country, surrounded by the Pacific Ocean and several seas. For that reason alone, fish has been a major animal protein source for the Japanese people throughout the centuries. Almost all the aquatic animals and plants available in adjacent waters are made use of by fishermen employing a variety of fishing gear and a range of vessel types and sizes. Fishing communities are well developed and widely dispersed around the entire coast of the country.

During the period of the old fishery law, numerous conflicts arose over the joint use of fishing grounds or fish stocks. Such conflicts occurred among users of the same gear as well as between users of different gears or of different sizes of fishing craft. Large-scale conflict sometimes occurred between neighbouring fishing communities. Due to a lack of fairness in principle and coordination in practice, the old law, which carried over traditional regulatory arrangements, was largely responsible for these problems.

The fishery law enacted in 1949 was designed primarily to realize the most effective and rational use of fishing grounds and fishery resources, the basic philosophy being that, through democratic organization by fishermen themselves, productivity would be stimulated and incomes and living standards eventually improved. To achieve this goal, the fishing rights entrenched under the old law were cancelled and replaced by modern democratic arrangements. An important mechanism for this purpose was the Fishery Coordinating Committee, on which fishermen were adequately represented. All proposals for the reallocation of fishing grounds and fishery resources among fishermen and fishing communities originated in this committee. In this respect, specific consideration was given to the avoidance of further disputes among fishermen, and to the conservation of the fishery resources involved.

3.2 Fishing Rights and Fishing Licence Systems

(1) The Fishing Rights System

Since coastal fishermen generally are powerless in the socio-economic sphere, the fishing-rights system is designed primarily to protect the coastal fisheries against deterioration from other fisheries. Under the fishery law, a fishing right is a recognized property right (right in rem). It may not be mortgaged, however, nor be rented or transferred. It is an exclusive right to fish in a defined water area with specified fishing gear - invasion by a third party is completely excluded. Examples of area and gear specification are provided in Figure 2 and Table 2.

There are three types of such rights, viz. common fishing rights, set-net fishing rights and demarcated fishing rights, a brief explanation of each being given in Table 1.

Common Fishing Right :

A common fishing right is granted only to fishery cooperatives and on condition that fishery resources are utilized in a coordinated manner by all members of the cooperative concerned. This type of right is further divided into three sub-types, viz: Type 1 for the harvest of littoral species attached to the seabottom, Type 2 for the use of small stationary gear at depths of less than 27 m and Type 3 for the use of beach seines. The allocation of resources and fishing grounds for each sub-type of operation and the selection of fishermen for engagement in each are determined in accordance with principles of equity and through a concensus of all members of a particular cooperative. The procedural details are defined in the statute.

The common fishing right corresponds more or less with the former exclusive right conferred by the old fishery law. The substantive difference is that Type 1 rights are confined to stocks of bottom-attached species, e.g. lobster, shellfish and seaweeds. Mobile species are thus made available for exploitation by means of other, more effective fishing gears.

Set-Net Fishing Right :

The set-net referred to in this categeory of right is defined as a net of this kind set at depths of more than 27 m. This means that the net is relatively large and that a substantial amount of capital is required for its construction and operation. For that reason, priority in the granting of set-net fishing rights is given to fishermen and groups of fishermen that have sufficient capital for the investment involved and experience in set-net operation. At an earlier stage, a number of individual fishermen obtained set-net rights but in recent years such rights are granted mainly to fishery cooperatives financially capable of handling the investment and operation. In the allocation of these rights, the sea area for the operation and the major species to be caught are specified. Due to the characteristics of this gear, however, a variety of species usually are taken.

Demarcated Fishing Right :

A demarcated fishing right is a right for the conduct of mariculture in a specific sea area. In principle, this right is granted to fishery cooperatives. Mariculture of finfish, crustaceans and molluscs also requires comparatively large amounts of capital. The same priority as mentioned for

Table 1

Illustration of fishing right and fishing licence system in Japan

	Type of Fishing Rights or Fishing Licences	Illustrated definition	Granted by	Granted to	Validity	Biological nature of resources being exploited
Fishing Rights	**1.** Common fishing right:					
	Type 1 (for littoral resources)	Right to harvest aquatic animals and plants attached to the bottom of the sea	Prefectural Gover-	Fishery cooperative	10 years	Littoral resources which do not migrate to other sea areas
	Type 2 (for stationary gear like small set net and set gill net)	Right to fish using stationary fishing gear at a depth of less than 27m. The net can be set any place within a sea area specified by the right	"	"	10 years	Mainly migratory pelagic resources and partly demersal resources
	Type 3 (for beach seine)	Right to fish using beach seine in a sea area specified by the right	"	"	10 years	Mainly migratory pelagic resources
	2. Set net fishing right	Right to fish using a barrier type set net at a depth of more than 27m. Sea area to set the net is specified by the right	"	Mainly fishery cooperative	5 years	Mainly migratory pelagic resources
	3. Demarcated fishing right	Right to use a sea area for mariculture	"	"	5 years	Any aquatic animal and plant for mariculture
Fishing Licences	**1.** Fishing licence issued by Prefectural Governor	Permit to fish using certain fishing gears specified by the Prefectural Governor	Prefectural Governor	Individual or juridical person	5 years	Any aquatic animal which remain in sea area directly off the prefecture (mainly demersal resources)
	2. Fishing licence issued by Minister of Agriculture, Forestry and Fishery	Permit to fish using certain fishing gears specified by the Minister of Agriculture, Forestry and Fisheries	Minister of Agriculture, Forestry and Fishery	"	5 years	Any aquatic animal which migrates over sea areas of two neighbouring prefectures or more (mainly pelagic fish)

Table 2

Example of Fishing Right granted to Nagai Fishery Cooperative 1/

Type of Fishing Right and Serial No.		Validity of the Right From	To	Location of Fishing Ground	Fishing Right is effective for : Species/Fishing Gear	From	To 2/
Common Fishing Right No. 6	**Type 1**	Sept. 1978	Aug. 1988	Sea area off Nagai village as indicated in the map	Lobster 3/	Aug.	May
					Octopus	Jan.	Dec.
					Abalone	April	Sept.
					Spiral shell	July	May
					Clam	Jan.	Dec.
					Sea urchin	Jan.	Dec.
					Lug worm	Jan.	Dec.
					Agar agar	April	Oct.
					Undaria	Sept.	May
	Type 2				Small set net for sea bream, barracuda, prawn and crab	Jan.	Dec.
	Type 3				Beach seine for horse mackerel, sea bass and sardine	Jan.	Dec.
Set Net Fishing Right	**No. 9**	Sept. 1978	Aug. 1983	ditto	Large set net for yellowtail, mackerel and sardine	Jan.	Dec.
Demarcated Fishing Right	**No. 86**	Sept. 1978	Aug. 1983	ditto	Yellowtail cage culture	Sept.	April
	No. 87	Sept. 1978	Aug. 1983	ditto	Sea Labour net culture	Jan.	Dec.

1/ This table is prepared to show briefly how Fishing Rights are granted to a fishery cooperative. Therefore, actual contents of Fishing Rights granted to Nagai Fishery Cooperative are not always the same as indicated above.

2/ Fishing periods for some species are specified in accordance with closed seasons determined by prefectural governor.

3/ Fishing gears used for common Fishing Right Type 1 are specified by the prefectural fishery regulation.

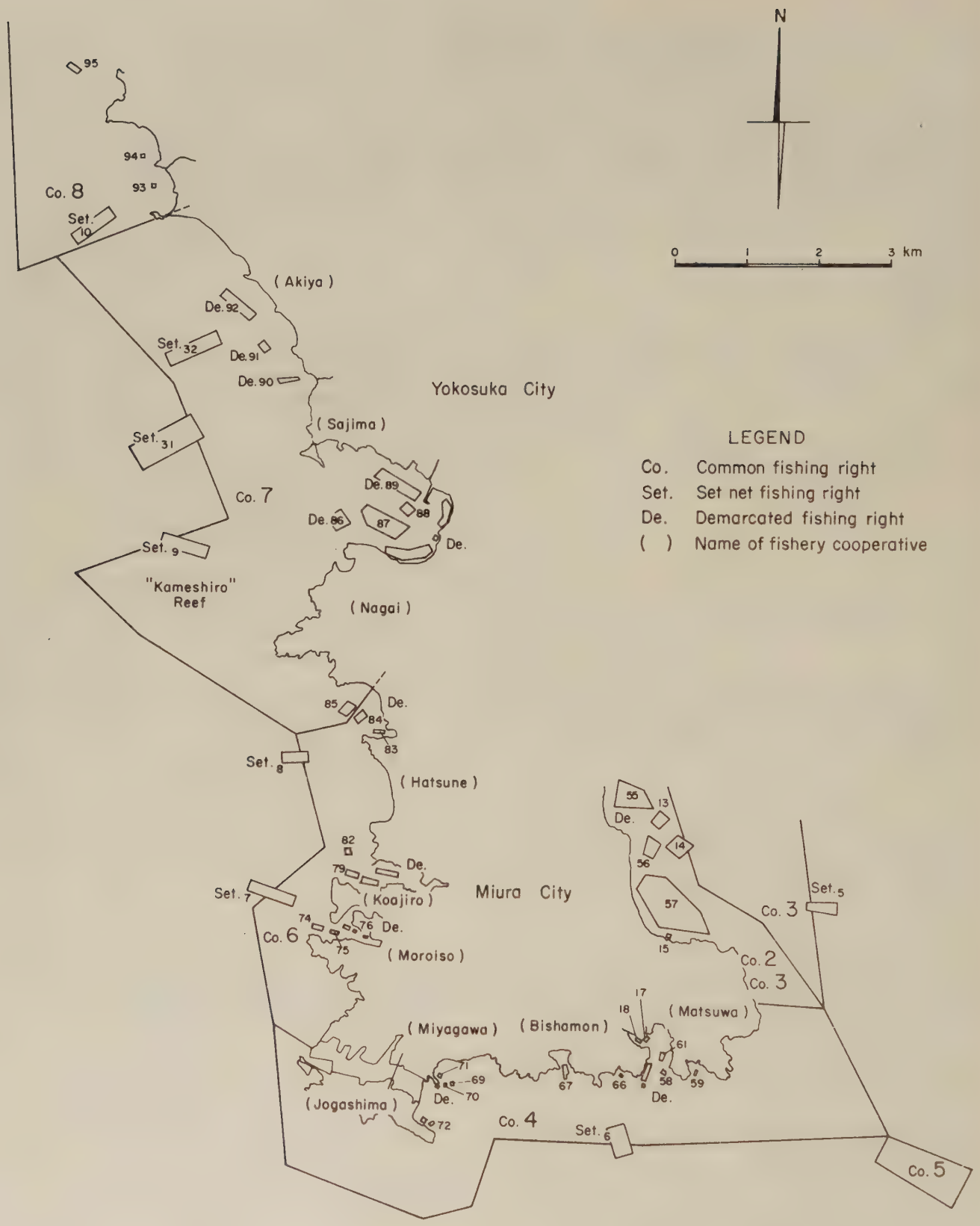


Figure 2. Illustration of fishing right system in Japan

LICENCE LIMITATION REGULATIONS: THE JAPANESE SYSTEM

by

Y. Asada
Fisheries Agency
Ministry of Agriculture and Forestry
Tokyo, Japan

GENERAL REVIEW

History of Fishery Regulations

In Japan fishing has been a long-established profession practised by numerous fishermen. The fishing grounds used and the resources exploited were subject to the technological level reached at a given period. Fishery regulations evolved accordingly and, as early as the 18th century, fairly good control measures were developed locally in many parts of Japan to protect resources and to maintain orderly fishing operations. However, it was not until 1901 that the national Government established a unified system of regulations covering the whole country. The purpose of this legislation, called the "Old Fisheries Law", was to coordinate fishing activities mainly in coastal waters, to prevent fishing conflicts, and to protect fish resources. This Law recognized and legalized a major part of the traditional institutions and practices. Subsequently, offshore and deep-sea fisheries were developed as an outcome of the growth of the productivity of coastal fisheries and the mechanization of fishing craft. This gave rise to frequent conflicts over fishing grounds. To solve these the "Old Fisheries Law" was amended several times and various regulations regarding offshore and deep-sea fisheries were established.

In 1949 the current law was enacted to replace the Old Fisheries Law. It reflects the "democratization" of Japan after World War II, and aims at increasing fishery productivity and the democratization of the fisheries regime through coordinated use of public waters by fishermen. The new law was substantially revised in 1962 to meet the changing fisheries situation.

Current Legislation

The current legal system consists of the basic Fisheries Law and related laws, such as the Fisheries Resources Conservation Law and the Fisheries Cooperative Associations Law; in addition, a number of control and coordination regulations, based on the laws, have been issued to provide further details of operation and control.

From a legal viewpoint, as Table 1 shows, fisheries are broken down into three main categories: Fishing Rights Fisheries, Licence Fisheries, and other fisheries. In respect of fishing grounds, the coastal fisheries consist mainly of Fishing Rights Fisheries and fisheries licensed by Prefectural Governors, while the main offshore and deep-sea fisheries are licensed by the Minister of Agriculture and Forestry. The relative importance of the three types of fisheries in 1970 is shown in Table 2. In terms of production, fisheries licensed by the Minister constitute as much as 60.1 percent, Fishing Rights Fisheries 14.8 percent, fisheries licensed by Prefectural Governors 9.6 percent, and other fisheries 15.5 percent. Around 1940 "Fishing Rights Fisheries" constituted as much as 65 percent of the total production. Thus, the relative importance of licence fisheries has gradually increased, particularly since the late 1950s. In terms of value, their relative importance is respectively 45.6, 26.4, 17.2 and 10.8 percent. It should be mentioned here that most of "other fisheries" were formerly free fisheries (where neither Fishing Rights nor licences are required). More recently, however, squid angling and the saury stick-held dipnet fishery, which together constituted more than 50 percent of "other fisheries", have become the fishery automatically authorized by the Minister, so that the relative importance of the "free fisheries" has been considerably reduced.

In terms of the number of fishery management units (enterprises), there are approximately 6,000 licensed by the Minister, representing only 2.6 percent of the 228,000 units in existence. The Fishing Rights Fisheries and those licensed by the Prefectural Governors are far more numerous.

Table 1 System of fishery regulations in Japan

A. Legal classification

Fishing rights	Fishing Licences
Exclusive rights granted by the Government to engage in specific fisheries in public waters. Treated as "Right in rem" (property rights).	All fishing activities under the licensing system are under general prohibition and specific exceptions are made by the terms of the licence. Hence, a licence is considered an exception from the general restrictions.

B. Illustration of the system

Fishing areas and types of fisheries	Direct regulation by Central Government	Regulation by Prefectural Government	Regulation by Fishermen's Organizations	Regulation by Coordination Committees
MARINE				
Coastal Area :		**Fishing Right granted by Prefectural Governor**		
a) Harvesting shellfish or seaweeds		Common fishing right	Operation regulated by fishermen's co-ops	Regional Fisheries Coordination Committees
b) Fish culture		Demarcated fishing right		
c) Setnet fishery		Setnet fishing right		
d) Boat fishery				
Offshore Area :	Designated by Minister and licensed by Prefectural Governors	Licence issued by Prefectural Governor		
Boat fishery **Deep-Sea Area :**	Licensed by Minister of Agriculture & Forestry			Central Fisheries Coordination Committee
FRESHWATER		Common fishing right		Freshwater Fisheries Control Committee
		Demarcated fishing right		

Table 2 Production by fisheries under fishing rights and licences (1970)

	No. of rights or licences	Landings (thousand metric tons)		Value (billion Yen)	
Fishing rights fisheries		1,372	(14.8)	255.2	(26.4)
Marine fisheries	23,501	1,260	(13.5)	214.5	(22.2)
Common fishing right	8,046	560		52.5	
Setnet fishing right	1,608	151		26.7	
Demarcated fishing right	13,847	549		135.3	
Freshwater fisheries	4,102	112	(1.3)	40..7	(4.2)
Common fishing right	1,120	64		9.0	
Demarcated fishing right	2,982	48		31.7	
Fisheries under the Minister's licences	6,994	5,610	(60.1)	442.5	(45.6)
Fisheries under Prefectural					
Governors' licences	121,000	892	(9.6)	166.7	(17.2)
Marine fisheries	103,000	836	(9.0)	158.7	(16.4)
Freshwater fisheries	18,000	56	(0.6)	8.0	(0.8)
Others		1,441	(15.5)	104.8	(10.8)
TOTAL :		9,315	(100%)	969.2	(100%)

US$ 1.00 = 300 Yen, approximately

Fisheries Based on Fishing Rights

The Fishing Rights system is the basic institution controlling the coastal fisheries of Japan. Fishing Rights are broken down into: Common Fishing Rights; Set-net Fishing Rights; and Demarcated Fishing Rights.

Common Fishing Rights are those that enable fishermen to exploit a certain area of water in common: to harvest shellfish, seaweeds and other sedentary animals; to operate small types of fixed fishing equipment; or to operate small mobile fisheries such as beach seines and seines set from non-motorized craft.

Common Fishing Rights are granted only to fishermen's cooperatives made up of coastal fishermen. Details of operation of Common Fishing Rights are decided at a general meeting of the fishermen's cooperative. Common Fishing Rights, the duration of which is usually 10 years, have been granted for all the coastal waters of Japan.

Set-net Fishing Rights are rights to operate set-nets where the main part of the net is fixed in water more than 27 m deep. These rights are granted to fishermen or entrepreneurs who meet certain requirements, i.e. who agree to abide by fishery regulations, not to hinder the democratization of fishing communities, etc. First preference is given to fishermen's cooperatives, and second to fishing cooperatives, whose members live in the local coastal area. The duration of the rights is usually 5 years.

Demarcated Fishing Rights enable holders to engage in fish culture wihin a given coastal area. In the case of marine fish culture, including breakwater and pearl culture, the rights are granted to applicants who fulfil certain qualifications. For laver culture, oyster culture, and yellowtail culture, priority is given to fishermen's cooperatives in the local area. The members of the fishermen's cooperatives engage in culture operation according to regulations decided upon by the cooperatives. Duration of the rights is 10 years for pearl culture and for marine fish culture with breakwaters, and 5 years for other culture operations.

Fishing Rights are monopolistic and exclusive rights to engage in certain fisheries in certain areas of public waters. Consequently, they are regarded as "Rights in rem" (property rights), and the same provisions concerning land are applied to them in legal transactions, except that there are certain restrictions on lending, transfer, and mortgage. Prior to granting fishing rights the Government (normally the Prefectural Governors) draws up, after consultation with the "regional fisheries coordination committee", an overall programme for the utilization of each area, and defines the rights to be granted. These fishing rights are then granted to qualified applicants according to the established priorities.

Fishermen's cooperatives that have been granted Common Fishing Rights or Demarcated Fishing Rights may, by contract, give outside fishermen "Entry Rights", which enable them to operate in the area.

Fisheries Based on Fishing Licences

Legally, a fishing licence exempts an individual from general prohibitions declared for the purpose of conservations or the maintenance of order in the exploitation of fishing grounds. There are two categories of fishing licences: those granted by the Minister of Agriculture and Forestry, and those granted by Prefectural Governors.

Fisheries for which licences by the Minister of Agriculture and Forestry are required

Fishing licences granted by the Minister are required in order to engage in fisheries for which national control is considered necessary, because of the large size of the vessels employed, the wide area of fishing operations, the existence of international fisheries agreements, the nature of the fishing grounds, etc. These fisheries are designated by the National Government by means of a cabinet ordinance, after consultation with the Central Fisheries Coordination Committee. The following 17 fisheries 1/ have been designated according to the above procedure:

1. Offshore trawl fisheries employing vessels of 15 gross tons or more
2. Trawl fisheries in the Yellow Sea and the East China Sea employing vessels of 15 gross tons or more
3. Deep-sea trawl fisheries employing vessels of 15 gross tons or more
4. North Pacific longline/gillnet fishery
5. Factory-ship trawl fisheries
6. Large or medium purse seine fisheries normally employing vessels of 40 gross tons or more, but 15 gross tons or more for certain fishing grounds
7. Large-scale whaling, with catcher boats of 100 gross tons or more
8. Small-scale whaling
9. Factory-ship whaling
10. Deep-sea tuna longline fisheries, with vessels of 70 gross tons or more
11. Offshore tuna longline fisheries, with vessels from 20 to 70 gross tons
12. Factory-ship tuna longline fisheries
13. Medium-scale salmon gillnet fisheries, with vessels of 30 gross tons or more
14. Medium-scale salmon longline fisheries, with vessels of 10 gross tons or more
15. Factory-ship salmon fisheries
16. Factory-ship crab fishery
17. Pearl shell fisheries

1/ All these fisheries are defined in the relevant Laws and Regulations by size of vessel, fishing gear, equipment, or fishing area, but details are not given in this paper.

The procedures for licensing are the following:

(a) The number of vessels to be licensed is determined for each fishery after consultation with the Central Fisheries Coordination Committee by size-class of vessels, by fishing area, and by periods of operation. The decision on the number of the vessels is based on such considerations as conservation of fish resources, maintenance of order in fishing operations, the number of fishing units already engaged in the fishery, and managerial and financial aspects.

(b) The number of vessels to be licensed is announced publicly.

(c) Applications for licences are made.

(d) The Government examines the applicants' qualifications, which include evidence that: the applicants will abide by the laws and regulations concerning fisheries and labour; the vessels meet necessary technical standards; applicants possess sufficient capital to engage in the fishery concerned.

(e) Those who meet the qualifications are given licences according to the following order of priorities: first priority is given to those already engaged in the fishery in question; if there is room for new entrants, an important consideration is whether the applicant is transferring from another fishery and whether such a transfer would have a favourable impact by decreasing pressure on resources and by lessening operational conflicts among fishermen. Favourable consideration is also given when a fisherman who is employed in the fishery in question proposes to become an independent entrepreneur by obtaining the licence.

The above procedure is used at the time of general renewal of licences. At other times licences are granted automatically in the following cases: when someone engaged in the fishery whose vessel has sunk or ceases to be used applies for a licence for a vessel of the same size; when an applicant has purchased a vesel already licensed for the fishery in question. (Advantage is taken of this procedure in order to increase the size of vessels. The licences are transferable at a certain market price; this aspect will be touched on later in this paper.)

Fisheries for which fishing licences are required from Prefectural Governors

The fisheries for which licences are issued by Prefectural Governors are broken down legally into those specifically designated by the Minister of Agriculture and Forestry to be licensed by Prefectural Governors, and those licensed by Prefectural Governors on their own initiative.

The first category includes fisheries considered sufficiently important for the coordination of nation-wide activities that the Minister fixes the maximum number of vessels to be licensed for each of the prefectures. These fisheries comprise those next in importance to fisheries licensed by the Minister. They include small-scale trawl fisheries employing vessels of 15 gross tons or more, medium-scale purse seine fisheries with vessels from 5 to 40 gross tons, trawl fisheries in the Seto Inland Sea with vessels of 5 gross tons or more, and small-scale salmon gillnet fisheries with vessels of less than 30 gross tons.

The second category covers those fisheries that Prefectural Governors feel should be regulated in order to coordinate fishing operations at the prefectural level - coastal or offshore fisheries such as gillnet fisheries, troll fisheries, pot fisheries, octopus fisheries, and fisheries using diving equipment. Governors' Licences are issued, as in the case of Minister's Licences, both on fisherman/entrepreneur and on vessel bases. Where the total number of vessels in a fishery is fixed for the purpose of coordinating fishing operations, certain qualifications and priorities are used.

Restrictions and prohibitions

Fisheries licences are subject to certain restrictions and prohibitions, which constitute a part of the licence. Some examples are:

(a) Prohibited areas:
Operation in certain areas is prohibited in trawl, purse seine and salmon fisheries, with a view to coordinating with the operation of coastal fisheries.

(b) Closed seasons:
During certain periods of the year fishing is prohibited in offshore trawl fisheries, small-scale trawl fisheries, purse seine fisheries and saury stick-held dipnet fisheries, for resource conservation and the coordination of fishing operations among fishermen.

(c) Restrictions or prohibitions regarding vessels or equipment:
These include restrictions on vessel tonnage and engine horsepower in small-scale trawl fisheries; mesh size regulations and limitations on the number of nets used in trawl fisheries in the Yellow Sea and the East China Sea and the salmon gillnet fishery; and limitations on the power of lights used in purse seine fisheriès and saury stick-held dipnet fisheries.

(d) Other:
Restrictions are placed on species that may be caught, minimum sizes of fish retained, and ports of landing; taking female crabs is prohibited, etc.

Fisheries Coordination Committees

The fisheries control system aims at increased fishery production and the democratization of fisheries. The fisheries coordination committees in which fishermen/entrepreneurs actively participate are instruments for achieving these aims.

There are three kinds of fisheries coordination committees: Regional Fisheries Coordination Committees, Joint Regional Fisheries Coordination Committees, and the Central Fisheries Coordination Committee.

A "Regional Fisheries Coordination Committee" has been set up in each of 64 areas (in principle, one for each prefecture). The Committee functions to advise the Prefectural Governor to draw up an overall plan for utilization of fishing grounds, and to establish or amend Prefectural Fisheries Regulations that provide for granting of fishing rights or licences, or to take other legal action; to prohibit or control fishing operations whenever this is necessary to ensure proper use of fishing rights, to coordinate fishing operations or to prevent conflicts in the use of fishing grounds; and to arbitrate the establishment or amendment of the rights of a third party to participate in fishing in the area concerned.

The Committee normally consists of 15 members; 9 are elected from among fishermen/entrepreneurs and employee fishermen, 4 are men with knowledge of and experience in fisheries, appointed by the Governor, and 2 represent interests of the community, also appointed by the Governor. The term of office is 4 years.

A "Joint Regional Fisheries Coordination Committee" is set up as needed, to deal with specific problems arising between regions. A Committee consists of members appointed from among the members of the Regional Fisheries Coordination Committees concerned, equal numbers of members from each. Joint Regional Fisheries Coordination Committees have been established in the Seto Inland Sea, the Ariake Sea, and the Genkai, where fishing grounds are exploited by fishermen from a number of different regions.

The "Central Fisheries Coordination Committee" is an advisory organ for the Minister of Agriculture and Forestry, and is consulted on certain important matters concerning enforcement of the Fisheries Law. The Committee consists of 25 members with knowledge of and experience in fisheries.

The Minister consults this Committee when he issues or changes ministerial regulations dealing with the designation of fisheries to be licensed by the Minister, such as the number of vessels to be licensed and the establishment of criteria for licensing and regulatory measures.

Regulations of Freshwater Fisheries

Special features of the inland fisheries control system include coordination of interests of commercial fishermen and sports fishermen, and provisions for obligatory fish breeding activities to be carried out by holders of fishing rights.

FISHING OPERATIONS UNDER THE CURRENT SYSTEM OF REGULATIONS

Japanese Fisheries that Permit no New Entries

The Japanese fisheries, including the coastal, offshore and deep-sea fisheries, are controlled and coordinated as a unit. This reflects the fact that, in their development from coastal fisheries to offshore and deep-sea fisheries, they have always faced the problems of fishing effort in relation to fish resources available, and conflicts of interest among fishermen both within the same fishery and between different fisheries. Almost all fisheries are controlled and limited. The only fishery of importance where entry is still open is the coastal angling fishery using small boats. In most other fisheries there have been few if any increases in the numbers of licences issued. Although the domestic demand for fish has considerably increased in relation to supply in the last 10 years, causing a considerable rise in fish prices and increased imports, the total number of establishments decreased from 235,000 in 1960 to 228,000 in 1970 (Table 3). During the same period, the number of units engaged in offshore and deep-sea fishing with vessels of more than 10 gross tons has scarcely changed. The total number of fishing vessels increased slightly from 1960 to 1965 but, since then, a downward trend can be observed, both for coastal and for offshore/deep-sea fisheries (Table 4). In particular, there is very little possibility of new entries in fisheries licensed by the Minister, since the number of vessels is fixed with respect to each fishery and, as noted above, at the time of renewal of licences priority is given to those who are already engaged in that fishery. Thus, to enter these fisheries, an individual must first have been a fisherman employed in the sector, and he must purchase a fishing licence from an existing licence holder.

Table 3

Number of fishing establishments * (in thousands)

Year		1960	1965	1966	1967	1968	1969	1970
Coastal Fisheries :								
Boat fishery:								
Non-powered	No.	70.0	32.4	26.3	22.6	20.1	15.5	12.9
	%	(29.8)	(14.5)	(11.7)	(9.9)	(8.8)	(6.7)	(5.7)
Powered		94.0	111.8	115.5	119.5	126.1	131.3	129.9
		(40.0)	(49.9)	(51.6)	(52.6)	(55.1)	(56.6)	(56.9)
Other fishery:								
Setnet, beach seine		10.4	8.6	8.4	8.2	6.9	7.3	7.4
		(4.4)	(3.9)	(3.7)	(3.6)	(3.0)	(3.1)	(3.2)
Marine culture		50.8	62.0	64.7	67.9	66.5	68.5	68.4
		(21.7)	(27.7)	(28.9)	(29.8)	(29.1)	(29.5)	(30.0)
Total :		225.2	214.8	214.9	218.2	219.6	222.6	218.6
		(95.9)	(96.0)	(95.9)	(95.9)	(96.0)	(95.9)	(95.8)
Offshore and Deep-Sea Fishing		9.6	8.9	9.1	9.4	9.2	9.6	9.6
		(4.1)	(4.0)	(4.1)	(4.1)	(4.0)	(4.1)	(4.2)
Total (all fisheries)		234.8	223.7	224.0	227.6	228.8	232.2	228.2
		(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

Table 4

Number of fishing vessels (in thousands)

Year	1960	1965	1966	1967	1968	1969	1970
Coastal vessels (less than 10 t)	344.8	363.6	361.5	360.8	358.1	353.2	353.3
Offshore and deep-sea vessels	15.9	17.5	17.6	17.6	17.4	17.3	17.3
Total :	360.7	381.1	379.1	378.4	375.5	370.5	370.6

In fisheries under ministerial licence, these rules have served to control fishing effort, to expand individual enterprises, and to increase the size of fishing vessels and modernize their equipment.

Control of Fishing Effort

Fishing effort is controlled when it is considered to be too great for the available fish resources in the light of results of research, or when reduction of fishing effort is required as a result of international agreements. In fisheries licensed by the Minister there have been many instances where fishing effort has been cut by a reduction of the number of fishing vessels. Two different patterns have been employed. Where other fisheries were capable of expanding their effort, the Government arranged for the excess fishing power to be transferred to them. Where such an arrangement was not possible, fishermen/entrepreneurs who had to leave the fishery were compensated by those who remained, and benefited by the reduction of fishing effort.

The Fisheries Law stipulates that, at the time of renewal of a licence, if the number of applicants engaged in the fishery exceeds the announced number of vessels to be licensed, new licences will be issued taking into consideration the number of vessels owned by the applicant, the fishing record of the applicant, and the extent to which he depends on the fishery. Licences are renewed every five years without charge for the number of vessels considered reasonable from the viewpoint of resource conservation; legally, therefore, the Minister can reduce the number of vessels without any compensation to former licence holders. However, because of the priority given to those actually engaged in the fishing, continuation of a licence is practically assured. Investments are made and loans are extended by financial institutions taking licences as security. Without the system of compensation, non-renewal of a licence would be a considerable financial loss to its holder.

Reduction of the number of fishing vessels by means of transfer to other fisheries

In the offshore trawl fishery, which is a long-established one, the number of vessels licensed increased rapidly in the years of food shortage immediately after the second world war, and excessive fishing effort became noticeable around 1951. Since 1953 the Government has taken every opportunity to reduce the number of vessels.

In 1953 offshore trawling vessels were transferred to the tuna longline fishery which, at that time, was expanding rapidly. Government subsidies were given for remodelling the trawlers into tuna boats. By 1955 the trawler fleet was reduced by 111 vessels. In 1954, when factoryship salmon fishing started, licences for the catcher boats were granted only to those who withdrew from the offshore trawling. As a result there were 318 fewer trawlers by 1956. When deep-sea trawling developed in the North Pacific area from 1961 to 1964, 126 offshore trawlers were withdrawn and transferred to the new operation. Also, when licences were issued for deep-sea trawling in the South Pacific are, some were set aside to decrease the number of offshore trawlers by requiring the withdrawal of at least 50 gross tons. Furthermore, an offshore trawler owner was required to withdraw a corresponding tonnage from offshore trawling when enlarging the size of his vessel. By these measures the number of licensed vessels decreased from 2836 in 1951 to 990 in 1970 (Table 5).

Table 5

Number of licensed vessels in the offshore trawl fishery

Year	No. of vessels	Average vessel tonnage	Total tonnage (in thousand tons)
1951	2836	29	81
1955	1527	35	54
1960	1308	42	55
1965	1091	49	54
1970	990	56	56

It should be noted that, in recent years, enlargement of vessels has been aimed mainly at improving accommodations for the crew, and does not imply any great increase of fishing power of the vessels.

In order to ensure effective transfer measures it is necessary to place a new fishery under government control at an early stage of its development, and to specify the conditions of entry.

The normal procedure followed by the government is first to allow a limited number of vessels to carry out exploratory fishing. If the fishery is found to be feasible, it is placed under government regulation, and licences are issued only under certain conditions. Later the total number of licences may be gradually increased in the light of a careful review of operational results. Thus adequate but not excessive fishing effort is maintained.

Reduction of the number of vessels by means other than transfer

As the possibility of developing new fisheries has gradually decreased, it has become difficult to reduce fishing effort by means of transfer to other fisheries. It has therefore become necessary to reduce fishing effort by other means. This has created problems due to the practice of respecting the right of those already engaged in the fishery. When the system of regulations was established, it was suggested that fees be charged for granting fishing rights and licences. This proposal was abandoned because of the strong opposition of fishermen, who maintained that it would cause accumulation of rights and licences by those who have financial power, and that the fees might not be fed back to the fishing industry. Since licence holders do not pay fees, the Government is not legally required to pay compensation for cancelling the licences. Therefore, reduction of fishing effort has to be followed by mutual compensation among fishermen entrepreneurs. To facilitate this, however, the Government has assisted the industry by arranging loans and by granting subsidies for interest payments.

The trawl fishery in the East China Sea and the Yellow Sea is cited as an example. Although in this fishery some reduction has been made by transfer of vessels to the deep-sea trawl fishery and by strict mesh size regulations, fishing effort is still considered excessive. The financial position of fishermen entrepreneurs has been deteriorating, and this has prompted the industry to reduce the fishing effort by 15 percent of its own accord. The Government assists the industry by arranging loans and interest subsidies for those who remain, and must pay compensation to operators forced out.

In the light of the above experience, it appears that it would have been better if a system had been provided in the law so that fees are charged when granting fishing rights and licences, and the income used for compensation of those leaving. The principle of respecting the right of those currently engaged in the fishery has succeeded in preventing new entrants but, on the other hand, has constituted an obstacle to the reduction of fishing effort.

Improvement of Efficiency of Individual Vessels

Fishing effort is controlled primarily by limiting the number of fishing vessels licensed, by size (gross tonnage). When required, additional restrictions are made regarding fishing grounds, gear, seasons, number of nets, mesh size, horsepower, etc.

Direct control of the amount of catch has been exercised only on those species, such as salmon and whales, for which the Government has obligation by international agreement to limit the catch. Technological developments and increasing distances to fishing grounds usually require progressively larger fishing vessels, which normally result in an increase in total fishing effort. A "tonnage supplement system" has been developed to deal with this.

The Fisheries Law provides that licences can be inherited in case of the death or merger of licence holders, and that a licence for the same fishery can be transferred from a vessel that founders or ceases to be used to another vessel having the same specifications. It also prescribes that the Government shall issue a licence to anyone who purchases or rents a licensed vessel and applies for the fishery. The Government can give permission for alternation of the specifications contained in the licence, such as increase of tonnage of the vessel, change of the fishing area, etc.

The Licence System and Free Competition

There is need to ensure free competition among enterprises in fisheries in order to promote technical development even while total fishing effort is strictly regulated. Each country must find a system appropriate to it, since technical, social and economic conditions in the fisheries differ widely. In Japan the current system has evolved against the historical background that the Japanese fisheries have gradually developed from coastal to offshore and then to deep-sea fisheries. The amount of fishing effort has been brought under control in all three sectors in an integrated manner, with due consideration given to the rights of fishermen/entrepreneurs who are already engaged in the fishery, to the need for limitation of new entries, and the desirability of rationalizing enterprises and the competition among them. The system of tonnage supplements has been one means of ensuring competition among fishermen/entrepreneurs and of encouraging technological development. As the enlargement of fishing vessels has progressed, the total number of vessels has decreased, and the total fishing effort has been maintained at almost the same level.

PERSONAL VIEWS AND OBSERVATIONS ON FISHERY REGULATION SYSTEMS IN THE LIGHT OF JAPANESE EXPERIENCE

Significance of the Licence System

The purpose of controlling fisheries is two-fold. One purpose refers to resource management, to ensure the "maximum sustained yield", by preventing either over-exploitation or under-exploitation of resources. Another is to guide the fishing industry so that both enterprises and fishermen can play their proper roles in the national and international economies. The Fisheries Law therefore aims at the coordinated use of fishing grounds to increase fishing productivity, to provide a basis for resource conservation, to coordinate fishing activities, and to maintain order among fishermen and entrepreneurs.

Generally speaking, direct catch controls may be the simplest and most effective way to manage resources. This can be done by establishing a maximum total catch and leaving the catch of individual fishing vessels to free competition (the so-called "Olympic method"); or, by setting quotas for individual vessels.

The former method greatly facilitates technical advancement by encouraging competition among enterprises, but it eventually leads to excessive competition, over-investment, and financial difficulties. In the latter method competition among enterprises is not created so acutely but, since new entries are freely allowed, profitability falls and the industry stagnates. When fish prices rise constantly, as they do in Japan, new entrants will always be attracted, causing reduction of quotas for individual vessels. This is clearly an over-investment from the social viewpoint. Some sort of limitation on new entries is therefore required for both resource management and socio-economic considerations.

With respect to resource management, it may be argued that the Japanese system on controlling fishing effort by means of total tonnage allowed in a fishery is less effective than a direct catch control. However, the present level of skill in making estimates of resource size makes management based on catch control less accurate than one might expect in many cases. Also, from the viewpoint of enforcement of regulations, control of the number of vessels and their tonnage is much easier than control of catch by individual vessels, at least in Japan.

Although enterprises are limited by the total tonnage allowed in a fishery, there remains enough room for competition among them to encourage technological development, and this has led to fewer vessels of larger size. At the time of renewal of licences, the total number of vessels is determined in respect of the management of fish resources and commercial enterprises. In the case of new fisheries, the number can be increased gradually to avoid over-exploitation and over-investment.

Licence Fees

Restricted entry sometimes results in licence holders enjoying more than average profits. One way to deal with such a situation is for the government to regain the excess profits in the form of licence fees. If such fees are levied equitably, there will not be any fisheries that are particularly profitable, and the reduction or transfer of fishing effort will then be easier. It will also be possible to use the income from licence fees to compensate fishermen and entrepreneurs who withdraw from the fishery.

Although the system is not used in Japan, tenders for licences for fixed terms constitute a means of fixing reasonable fees. In order to ensure equitable distributions of licences, it would be necessary under such a system to limit the number of licences for individual fishermen/entrepreneurs to one each, and to make payment easier by allowing them to be made by instalments. When the term expired, tenders would be invited again. Anybody could bid and there would be no discrimination against the new entrants, but those already engaged in the fishery would usually be in a more favourable financial position.

The Japanese experience suggests that consideration of a licence fee system through tender would be worthwhile in countries where limited entry fishery regulations are being newly established.

The modernization and increased efficiency of fishing vessels has been encouraged in Japan by shortages of labour and the consequent rise of wage levels and need to improve labour conditions. A system of licence with limited entry stimulates such improvements.

Various Forms of Restrictions and Prohibitions

Japanese regulations include detailed restrictions and prohibitions for each fishery, e.g. the maximum number of vessels for each tonnage class, the legal fishing grounds, gear, seasons, amount of catch, etc. The more detailed and complex regulations are, the more opportunities arise for violations, and the more difficult enforcement becomes. It is thus desirable to keep the regulations to the minimum essentials.

From the viewpoint of administering the licence system, it would be desirable to restrict control to the indirect fixing of catch by limitation of fishing effort, and not to use direct catch controls except where considerable fluctuations of resources are expected. However, indirect control of fishing effort by fixing the total tonnage of fishing vessels requires the "tonnage supplement system" to facilitate the free choice of vessel size, thus contributing to technological advances. When, as a result of enlargement of size of vessels, an increase in fishing effort occurs that is considered to be too great, the supplementary tonnage required should be adjusted upward so that total fishing effort can be kept at the same level.

If the upper limit of enlargement of fishing vessels is set too low, owners may try to put extra equipment on the vessels and to enlarge the fish hold beyond proper capacity, so that accidents occur. It is advisable to fix the maximum limit of vessel tonnage at reasonable levels in consideration of distances to the fishing grounds, fishing methods, and equipment used.

The Japanese licence system started as a measure to prevent conflicts among fishermen/entrepreneurs and to encourage balanced development of the industry. The system evolved further by aiming at the coordinated utilization and management of fish resources. The character of the system is fixed by the special circumstances in Japan where, from ancient times, people have been heavy consumers of fish, where almost all fishes are marketable, and demands for various species can be substituted for each other. Under these circumstances, the approach to resource management has

been somewhat different in Japan compared with other countries. As an example, the regulations concerning the purse-seine fisheries for sardines, mackerels and horse mackerels are joint limitations on fishing effort for all these species, which are thus treated as a single mixed resource. This is because they migrate in the same area and there is evidence of a close mutual relation in their abundance fluctuations. Only for certain species of high price such as crabs, for which fishing effort may therefore be concentrated, have additional measures such as catch limitation had to be taken. In this respect the Japanese fishing situation is different from that of many other countries where fishing has often developed on a single species. Then a licence system like that developed in Japan might not be applicable.

CONTROLLING FISHING EFFORT: MALAYSIA'S EXPERIENCE AND PROBLEMS

by

Shahrom bin Abdul Majid
Department of Fisheries
Ministry of Agriculture
Malaysia

Introduction

All Malaysian marine fisheries are essentially small-scale conducted in shallow waters (under 50 m), predominantly within the territorial waters of 12 miles and only rarely beyond 30 miles. Prior to 1963, the Malaysian marine fish catch was taken by traditional gears such as bag nets, bottom gill nets and traps operating in inshore waters. At that time the greater part of the licensed fishing fleet operating in waters off Peninsular Malaysia was not motorized. In 1961, less than a quarter of the total licensed fleet of 22,959 was inboard powered. The fisheries had undergone a major growth in the late 1960s and early 1970s, with landings increasing from 300,000 tons in 1967 to 650,000 tons in 1981. This spectacular growth resulted mainly from the introduction of trawling for prawns in the west coast of Peninsular Malaysia; the licensed trawler fleet grew from a few vessels in the early 60s to 4,500 in 1981.

There were 44,851 licensed fishing boats in the country in 1981. Of these 25,365 or 56 percent were inboard fishing boats, 12,360 or 28 percent were outboard powered boats and 7,126 or 16 percent non-powered boats. The bulk of these fishing boats were concentrated on the west coast of Peninsular Malaysia. Of the 21,849 fishing boats on the west coast the majority (12,472) were inboard powered. The majority of these inboard powered boats were less than 15 GRT powered by 40 HP engines. There were 8,541 fishing boats on the east coast of Peninsular Malaysia, the majority (6,113) of which were also inboard powered boats of less than 15 GRT powered by engines of less than 40 HP. Of the total number of boats in Peninsular Malaysia, 83 percent are boats operating traditional gears.

The nature of the problem faced by the Fishing Industry

Analysis of catch and effort statistics and of the results of research surveys have led to the conclusion by the Malaysian Government that, despite the continuously rising catch trends, the stocks of both demersal and pelagic fish in the inshore fishing area are either intensively-exploited as in the east coast of Peninsular Malaysia or over-exploited as in the waters of the west coast of Peninsular Malaysia. This is supported by evidences of the virtual disappearance of certain commercial species of fish, in the persistent decrease in catch per unit effort, in the very high incidence (more than 80 percent in the 1981 landings) of trash fish in the demersal landings, of which a significantly large portion are composed of under-sized immature fish of commercially valuable species. Trends in landings have also declined in the last few years. Above all, the potential for increasing production appears to be limited to some less intensely-exploited areas of Sabah and Sarawak and off the east coast of Peninsular Malaysia in the deeper waters of the South China Sea. For the inshore areas of Peninsular Malaysia, in particular the west coast, fishing effort and investment need to be reduced to make the harvest more economically efficient in terms of manpower and capital and to conserve the various fish resources.

Besides the problem of the resource factor, the rapid development of the Malaysian fisheries in the early '60s and '70s have brought problems rather than benefit to the small-scale fisheries operating traditional gears.

These problems may be attributed to the deficiencies of fisheries plans to provide for effective management and promotion of the latter and to regulate the expansion of the trawl fisheries, in

particular the mini-trawl fisheries into the most productive fishing grounds where the small-scale traditional fishermen operate. The traditional fishermen were already in difficult socio-economic straits, with average income among the lowest in the nation. Further deterioration of their position due to disruption or displacement by the advent of trawling took place. Also prior to 1980 there were no clear cut strategies for the proper management of the fishery resources.

The problems therefore that prevail in the Malaysian inshore fisheries are an excess of fishing units and consequently too many fishermen, intense fishing and hence competition for limited resources, leading to decline catch rates and reduced income, especially in the traditional fisheries sector to which the majority of fishermen belongs.

Management measures

The management of the fishery resources prior to 1980 had been on a problem-oriented basis, that is, reacting to the problems as they appeared. Using the same approach after the introduction of trawling resulted in a series of decisions being taken on a disjointed-incrementation basis rather than within the framework of an overall plan for achieving optimum utilization of the resources. Another factor which led to and exacerbated this problem of lack of clear-cut strategies for the management of the resources was the absence of a sufficiently good data base for the planning of management strategies.

Management and conservation controls in force then included a minimum mesh size for cod-ends in otter-trawl nets of 38 mm (1.5 inches) internal extension measure, which was later reduced to 25.4 mm (1 inch), prohibition of the use of beam-trawl nets for catching prawns, demarcation of the distance from the coast within which otter trawling was not permitted and prohibition of night fishing by trawlers under a certain size.

This lack of sound management strategies in the context of intense-exploitation and over-capitalization led to the formulation of a management policy which was adopted in 1981.

The area of importance in the allocation of fishery resources is in the inshore waters, where the problem is one of allocating the fishery resources between the highly efficient and mobile trawlers and the traditional fishing gears.

The Fisheries Licensing Policy, initially formulated to solve the problems arising from the conflict between the traditional fishermen and the mini-trawler fishermen in the inshore waters, now encompasses fisheries as a whole in marine waters under the jurisdiction of Malaysia and addresses itself to:

(a) The elimination of competition and the ensuing conflict between traditional fishermen and mini-trawler fishermen in inshore waters

(b) The prevention of over-exploitation of the fishery resources in inshore waters

(c) A more equitable distribution of fishing throughout the waters under the jurisdiction of Malaysia

(d) The restructuring of the ownership pattern of fishing units in accord with the New Economic Policy

(e) Promotion of the development of offshore industrial fisheries

The main strategy employed is the allocation of fishing grounds through zoning. Four zones are established under the policy. The first zone, from the shore to 5 miles from the shore, is reserved for (owner-operated) traditional fishing gears; the second zone, between 5 miles and 12 miles from the shore, is reserved for (owner-operated) trawlers and purse-seiners of less than 40 gross tonnes; the third zone, between 12 miles from the shore and 30 miles from the base-line of territorial waters, is reserved for trawlers and purse-seiners greater than 40 gross tonnes and other fishing gears wholly owned and operated by Malaysians. Foreign fishing, including joint-venture or charter, is restricted to the fourth zone which is between 30 miles from the base line of the territorial waters and the outer limit of the Exclusive Economic Zone.

The policy therefore has to achieve the objectives enumerated in (a) and (e) above, established zones by type of fishing gear and size of boat, and ownership of the fishing unit to ensure a more

equitable distribution of fishing, fishing effort, ownership and benefits. Fishing effort will be further regulated through licence limitation in each zone to prevent over-exploitation. In the first and second zones, fishing units not operated by the owners will be phased out and only fishing units operated by the owners will be permitted.

The management and conservation controls formulated also include a minimum mesh size for otter-trawl cod-ends of 38 mm (1.5 inch) internal-extension measure and a prohibition of the use of the beam trawl and the pair trawl. Use of explosive, poison or electrical devices to catch fish is prohibited. Collection of cockles by mechanical means is also prohibited.

Issue and problems

The management policy elaborated above is not based solely on conservation of stocks. Major consideration is given to economic, social and political aspects. The main criteria was to control excess capacity, taking into account socio-economic and political considerations. The objective mix of equity with efficiency and resource yields adds to complication in the judgement of the appropriateness of the types of required techniques. Further complications arose out of insufficient data for administrators to make decisions or to defend the policy and out of difficulties in attempting to enforce regulations which were politically and socially unpalatable. Unless the fishery administrators could gain the acceptance by fishermen of the policy measures and support at the political level, the task ahead seemed daunting and insurmountable.

Lack of adequate information

The success of fishery management measures depends to a large extent upon the acceptance of the need and value of the measures by those who will be affected and by politicians. The decision on allocations involves a trade-off between the trawlers and traditional fishermen and also the exclusion of excess fishermen from the industry are obviously political decisions. It will be difficult for fishery administrators to follow through on the management programmes unless they have full support at the political level. The problem here is to be able to convince the political leadership of the necessity for government intervention and of the benefits of such intervention.

Although the management measures were accepted by the government, there was still a lack of full comprehension of the unique problem of the common-property fishery resource and the necessity for government intervention. This prevailed not only outside the implementing agency itself but also among the officers of the implementing agency. Consequently, the necessary support was not forthcoming. Although there is also a question of taking the line of least resistance in the face of political and social pressure, the nagging doubts of the necessity and benefits of the interventions were uppermost in the mind of these people.

It is important that the measures, if they are to be acceptable, have a high degree of accuracy and be backed up with sound scientific facts. This, in the administrator's mind, is of great importance in order to gain credibility and acceptance for whatever control is proposed.

In the Malaysian context it was evident that undesirable changes had occurred in the fisheries and that resources, or at least important parts of them, were over-fished. However, it was not enough for the scientist to make a general reference to 'over-exploitation' or to the fact that the 'maximum sustainable yield' (MSY) has been over-shot. What is lacking in the Malaysian scenario is adequate information to lend credibility to the efforts of the fishery administrator, and to assist them to make the necessary and right decisions whenever confronted with a situation which has to be resolved expeditiously if that credibility is to be retained. Moreover, fishery statistics, both biological and socio-economic, are the basis on which all programmes in marine fisheries must depend and the accuracy and completeness of these statistics are of obvious importance.

Malaysia presently suffers from a paucity of both biological and socio-economical and technical information and their analysis in the fishery sector. Adequate information on resources under intensive exploitation and on unexploited resources in areas and sub-areas are unavailable. Collection of statistics in Malaysia is by sampling at landing points. There is no routine programme to obtain accurate statistics of the fleets' catch and efforts, through requirement of fishing-vessel operators to provide records of their operation. No applied research has been carried out on the various types of

gears that are being operated and on the effect of the modification and innovation of these gears in the industry. The biology, locality and occurance of many of the various species of fish, prawn and mollusc that commonly occur in Malaysia are not known.

In the course of implementation of the management measures in 1981 and in 1982, the fishery administrators were confronted with the problem of not being able to estimate with confidence the number of licences to be issued for each fishery in each State and for sub-areas within the States. When trawler boats applied for additional seasonal licences to operate purse-seine nets, the administrators were unable to make a decision due to lack of information on the seasonality of the fish to be caught, the locality of the stocks and whether the present number of licences for purse seines could be increased. The advice given to the fishery administrators, that they could increase the number of purse-seine licences by an additional nine, was obviously inadequate. To whom could the fishery administrators issue the licences, to which States or sub-areas of the west coast, to what sizes of boats and for how many months? How was the figure of nine derived at? These were unaswered questions.

Information on the optimum size, horse-power and tonnage of boats to be recommended, to allow trawlers and purse seiners to fish effectively beyond the compulsory five-mile zone, was also unavailable. As a result, the fishery administrators were compelled to go on licensing boats below 10 GRT; they were not competent to make a decision on the matter though they suspected that these sizes of boats could not effectively operate using trawl nets in the deeper waters beyond five miles.

The fishery administrators also could not make a decision on the limitation of engine power, size and tonnage of boats to be imposed in the various fisheries, or on the replacement of old boats, as again adequate relevant information was not available.

Neither could they recommend alternative methods of operation for certain fisheries when they were compelled to ban certain destructive gears in use.

In short, the fishery administrators were in a 'no win position'. Lack of information could not delay action to limit over-capacity; catch per unit effort series over the years showed a consistent downward trend, indicating considerable pressure on the fishery. On the other hand, they were not provided with sufficient information to support the management measures they were implementing or to allow them to make decisions in the course of their work. In such a situation the fishery administrators either chose to postpone the decisions or make them based on rough estimates of relevant conditions. In such an atmosphere it is not surprising that they were unable to retain their credibility with the politicians, the fishermen and their colleagues.

It is therefore necessary for Malaysia to be able to define the stocks available for exploitation by species and sub-areas, to determine the composition of the stocks and of the catches with respect to the abundance, age, size and sexual maturity, and to measure the effects of fishing on the stocks. Such information is necessary in order to measure the potential productivity of the stocks relative to their harvest capacity and to be able to predict the effects of alternative methods and levels of harvesting. It is also necessary for applied research on gear and boat operation and development to be initiated. Finally, information is required on the economic and social framework in which the Malaysian fisheries operate, such as cost and earnings of the various tpes of boats and gears to permit decision on licences fees, etc.

Poor linkages

It is also obvious that one of the main problems in Malaysia is the poor linkage between the Fisheries Research Section, the Statistics Section and the Management Section responsible for the planning and the execution of management policies and measures in the implementing agency.

It is without doubt that there needs to be a close linkage and rapport between these three sections. The latter needs much more regular and up-to-date information on what is happening to the resource and to the fishery, and the research and statistics sections need to be more closely focussed on providing these information. Also the needs of the research section for better information must be clearly spelled out and be taken into account in the design and conduct of the statistical collection programmes.

Financial assistance

A further impediment to actions to control excess capacity is that the policy and the personnel of the implementing agency prior to 1980 were attuned to increased fish production and raising the incomes of fishermen. Management personnel have not become fully aware of the urgency of the resource problem and of excess capacity. Moreover, faced with political and social opposition, it is only human for these people to take the line of least resistance. Policy decisions which were initiated earlier and have yet to be reviewed are not fully rational and consistent with the present management policy. A case in point is the subsidy programme for the fishery sector which was initiated in the 1970s and is still in operation in 1982. Subsidies for equipment and boats totalled $15.3 million in 1981 and $10.5 million in 1982.

In a recent reorganization of functions the Malaysian Government had decided to transfer the responsibility for subsidization to another agency, a quasi-government fishery body, one of whose tasks is to promote the socio-economic well-being of the fishing community. The question of coordinating the functions of the two government agencies serving the objective of controlling excess capacity in fishing effort would be a matter of utmost importance.

The subsidy programmes initiated in the 1970s were based on the reasoning that the promotion of boat ownership is a suitable measure for poverty eradication. There is, however, no clear cut emperical evidence that this is the case. All subsidized units of fishing boats were assured of a licence irrespective of the limitation imposed on fishing effort by the government. This capital-intensive strategy, together with easy entry conditions into the industry, have probably increased labour under-employment and exacerbated the poverty situation. These programmes serve as an incentive for resources to move into or for excess effort and resources to be retained in the marine fisheries sector, thus leading to further depletion of the stocks and lowering of income among inshore small-scale fishermen. The opposite is required if the problem of poverty and over-fishing is to be effectively dealt with.

Subsidies on boats, equipment and particularly diesel engines aggravate the inherently strong tendency in fisheries development toward excessive investment and effort. They thus contribute toward and accelarate deterioration of the resource and reduction of income among existing fishermen and thereby increase hardships in the long run.

Lack of coordination with other Agencies and Sectors

The fishery sector is part of the country's ecosystem and thus is subject to prevailing environmental, economic, social and political conditions in the community and society at large. The success of management programmes cannot depend on implementing them per se in isolation but must take into account the interplay of other activities within and outisde the fishery sector. Often objectives and actions of other sectors conflict with those of the management objectives. These activities may not provide a condusive environment for the success of the management programmes and in fact often act as an impediment to the measures propounded.

The concept of over-capacity had been accepted by the government in general but what has been obviously absent in the implementation stage is a total commitment to the policy at all levels. Part of the blame is due to the non-involvement of other relevant agencies right from the planning to the implementation stage and that there has been no specific body, at a high enough level, to direct and coordinate the necessary actions of the various government agencies.

The success of a licence-limitation scheme depends to a large extent on reallocation of the excess fishermen from the fishery sector and this is dependent on the environment outside the fishery sector and also on the socio-economic conditions of the fishing community.

Over the long run, diversion of excess numbers of fishermen will be most successfully met by development of increased opportunities for satisfactory employment in non-fishing activities. On the other hand, the amount of entry into a fishery will be high if there are few satisfactory alternative opportunities for employment.

The fishing community is geographically isolated from the rest of the country and for relocation to be accomplished a condusive environment must be provided by the government.

Firstly, there is a requirement to increase the educational level of fishermen and their families to enhance their job opportunities. Secondly, training for skilled jobs, for example, in the construction and plantation sectors where there are high labour shortages, must be provided. There is a need for such training schemes to be specially initiated for the fishing community. Previous efforts for the transfer of fishermen under general land schemes organized by the government have been inadequate and efforts need to be made for such schemes to provide specifically for the fishing community.

All these requirements would involve the assistance of other government agencies such as the Fisheries Development Authority of Malaysia, which is in charge of socio-economic welfare, subsidization and finance for fishermen, the State Government which have authority over utilization of land, the Federal Land Development Authority responsible for land schemes, the agencies responsible for skilled training, the Ministry of Education, etc.

It is also important to ensure that other government agencies responsible for fishermen be made aware of the management policy and that an effort be made to see that their policies are not counter-active to the policy to remedy over-capacity.

Lack of incentives

Licence limitation requires a distributive decision. An incentive for compliance would obviously involve some form of compensation.

The fishery administrators are presently faced with the problem of enforcing the 5-mile and 12-mile zones for trawlers and purse-seiners below and above 40 GRT, respectively. The majority of these boats are below 10 GRT and it is suspected that such sizes of vessel can effectively operate outside the 5-mile zone in deeper waters. No compensation is included in this displacement programme. Fishery administrators find it difficult therefore to enforce this regulation. Those fishermen who can afford to build new boats to fish effectively in the new zone are reluctant to destroy their old boats. On the other hand, if the destruction of these old boats is not enforced, they all inevitably end up operating illegally.

Enforcement of this measure must therefore be facilitated by some form of compensation for those displaced or those being excluded. Without such incentives the cost of enforcing the measure may be comparatively high. However, before such a scheme can be initiated, there is a need for a study of the socio-economic profile of the fishermen involved.

The problem of enforcement

The final and most difficult problem relates to the obstacles faced in ensuring that the necessary regulations were complied with and to the cost of such effective enforcement.

Before 1980, enforcement was carried out on an ad hoc basis by the different State Directors of Fisheries. There was no link-up with other government agencies assisting in the enforcement of fishing activities.

In 1980 the enforcement unit of the Fisheries Department was enlarged and reorganized into four regionally-based sub-centres in Peninsular Malaysia. Three on the west coast, one of which covered both east and west coast and the last one in the northern region of the east coast. The number of patrol vessels increased from 15 in 1979 to 25 in 1982 and speed boats from 22 in 1980 to 39 in 1982. In 1983 there will be an additional six patrol vessels.

There is close liaison between the Marine Police, the Navy and the Fisheries Department, all three agencies being responsible for enforcement of fishery regulations in the territorial waters and EEZ. To facilitate this, ad hoc committees were formed in 1981 at Headquarters in Kuala Lumpur and at the regional bases in the States.

The main problem faced in enforcement, however, comes from the lack of political will. Unless and until the fishery administrators gain the support of the politicians in their efforts to enforce the

management regulations, effective enforcement will never be realized. In the case of a complaint from inshore fishermen in one of the States, the enforcement unit of the Fisheries Department took special operative actions and arrested 14 trawler boats caught blatantly infringing and operating in the 1-1½ mile zone. Subsequently the fines of these trawler fishermen were reduced to nominal sums.

One of the problems of enforcement has been the lack of facilities to maintain and store the boats arrested. Boats caught were released on nominal bonds by the court. These boats more often that not proceeded to continue their illegal operations, and sometimes were not surrendered to the authorities when they were directed by the court to be confiscated. Court action normally occurs after a period of one to two years.

From the outset, the enforcement of management maesures was beset with problems, one of these being the timing of the measures to be implemented. Action could have been much easier if taken before over-capacity had already set in.

In Malaysia's case over-capacity already existed, not only in terms of licensed boats but in quite a substantial number of illegal boats which have been operating for as long as three to four years undisturbed by the authorities for a number of reasons. One of the reasons was that enforcement was not organized and therefore non-effective prior to 1980. Secondly, government personnel in charge of fisheries were more attuned to the policy of production rather than management of over-capacity. There was therefore no urgency for effective enforcement of the management regulations then and the result is that these illegal boats are now a part of the status quo, and to remove them would not be socially or politically acceptable.

When the licence limitation scheme was implemented, very small-scale inshore fishermen operating small boats called 'sampans' were not taken into account. These part-time fishermen were responsible for less than one percent of the total catch. Their catches supplemented their meagre income from other sources and fishing comes automatically to them as they live along the coast, and the small 'sampsans' were cheap to build. Enforcement of the regulation in their case, therefore, was undesirable and also impractical as they were scattered all over outlying places in remote areas often inaccessible by patrol craft.

Remedial actions taken

The Fisheries Department of Malaysia is very much aware that accurate appraisal of the status of the stocks and of the fisheries that harvest them is a number-one priority for effective management and development of the fisheries.

It sees the need for a linkage between the Management Section of the implementing agency and the Research Section.

The first step it has taken in this direction is to give a mandate to the Management Section to coordinate activity with the Statistics Section and Research Section, involving the types of statistics to be collected and the applied research to be carried out. The Management Section has also been given the mandate to direct and coordinate the relevant sections to assist it in solving the day-to-day resource problems it is confronted with and to carry out applied research work in anticipation of any regulation programme to be implemented.

For 1983 the Management Section is setting up an Intellegence Unit which will be responsible in conjunction with the Research and Statistics Sections to supply all relevant information and analysis on the Malaysian fisheries resource. This unit will also be responsible for the introduction, on a pilot basis, of a log-book system in some of the more advanced elements of the Malaysian fleet. It will also be responsible for monitoring the fishing effort of foreign fishing vessels or joint-venture vessels which may be licensed in the future. Part of its task also will be to look into computerization of the data on licensed boats and on the setting-up of a monitoring, control and surveillance system in territorial waters and the exclusive economic zone.

The Statistics Section of the implementing agency is in the process of reorganizing its structure and is looking into the possibility of using computers in data collection.

The Research Section is also in the process of being reorganized to meet the tasks required of it. "Effective conduct of such tasks would involve dedication of a substantial portion of the governments marine research capability to 'mission-oriented' work closely tied in with the Implementing Agencies management programmes" (Preliminary Report of FAO/MCS Mission on the EEZ of Malaysia). However, what is disturbing to the Management Section of the Fisheries Department is a proposal to set up a separate Fisheries Research Board which would have overall responsibility for fisheries research in Malaysia. Surely the knowledge of the disadvantages of establishing a separate research body, which may not respond effectively to the urgent needs of the administration and of the expanded responsibilities of the Fisheries Department for the management of the EEZ (requiring as they do, more research information), makes a very strong argument for tying research even more closely to fisheries administration rather than separating them. It is hoped that the disadvantages of this proposal will be realised and taken into account when the final decision is made.

A decision has been made to issue (personal) to-holder licences to the very small-scale inshore fishermen operating 'sampans'. These licences will allow them to fish solely for the purpose of their daily requirements. Their small catches are not expected to affect the resource situation.

A survey of all illegal boats which had been operating for the last three to four years had also been carried out in 1982, and a decision would have to be made in 1983 whether to license them or not. There is strong political pressure to license these illegal boats on the reasoning that they have been in operation for a number of years. There is a promise of political support for enforcement of a ban on illegal operations subsequent to the legalizing of the present lot.

In such a case the enforcement unit of the Fisheries Department is again in a "no win position".

The Malaysian Government is taking steps to locate some alternative source of imployment in the Fisheries Sector itself: by promoting aquaculture and liberalizing licences for deep-sea fishing.

Conclusion and Recommendations

The most important element for the success of the management measures elucidated above is that they need to be supported through the political process. Without such support, fishery administrators will find it difficult if not impossible to adopt and implement effective management measures. The gaining of this support is an important step for the administrators.

Secondly, there is a need for the coordination of all relevant government agencies that are involved directly or indirectly with fisheries development in order to ensure that their policies and activities are not counter-productive to the management policies and measures taken. The continued subsidization of various elements of fishing effort in terms of existing low-cost loans, subsidies, etc. should be critically reviewed as to objectives and consequences, subordinated to the main task of resource conservation and management, and perhaps drastically reduced. As has been pointed out earlier, these measures instead of alleviating poverty may only exacerbate it.

There is also an urgent need to get the involvement of other agencies in the reallocation of excess fishermen through such programmes as those for creating alternative job opportunities, providing skilled training in fishing communities and the initiation of a special land scheme for fishermen.

What would be required perhaps is the formation of a high-level committee of civil servants from the various relevant ministries and agencies. This committee would then be given the mandate to direct and coordinate the various activities of the government in reallocating the excess fishermen. In short, there needs to be a total commitment to this task at a very high level.

There is a further need to look into compensation for the fishermen to be reallocated or excluded from the fishery sector. In this context, what would also be required is a survey of the economic profile of the fishermen affected by the management measures implemented.

There is a need to review the licence fees being levied presently. These fees are not commensurate with the catching power and effort of the fleet. It only takes two Malaysian ringgit

(equivalent roughly to one American dollar) for a licence to fish. A high licence fee, specifically related to the catching power of trawlers and purse seiners should be imposed.

There is, finally, an urgent need to develop the capability of the Management and Research personnel of the implementing agency in their area of work, by providing the necessary facilities and training requirements. At present, very low priority is being given to this important aspect; one cannot hope to implement successful management policies without properly trained manpower.

It is without doubt that the fishing effort in Malaysia is excessive and over-capacity exists. A shortfall in the support necessary for the management measures proposed should not be an excuse for delaying action. The various problems discussed above show that there is a need for Malaysia to seriously study the various impediments faced by fishery administrators in the formulation and implementation of management programmes in order to ensure the effectiveness of the management measures taken.

VESSEL LICENCES, GEAR CONTROL AND FISHERMEN LICENSING IN AUSTRALIA: Australian Experience of these and Related Management Measures

by

R. Bain
Fisheries Division
Department of Primary Industry
Canberra, ACT, Australia

1. INTRODUCTION

The Australian fishing zone (AFZ), which was declared on 1 November 1979, is one of the largest fishing zones in the world. However, the current output of Australian fisheries, about 15,000 tonnes valued at A$390 million, represents less than 0.2 percent of the total world production. The major developed fisheries in Australia are shown in Figure 1. The primary reasons for Australia's small production are the relatively low biological productivity of Australian waters and the relatively small size of the domestic market for fresh fish. In 1981/82, exports - chiefly crustaceans and molluscs - were valued at A$325 million, and imports - mainly comprising canned and frozen fish - were valued at A$218 million.

The Australian fishing industry maintained its profitability through much of the 1970s, assisted by rising real prices for most of its exports. However, the rise in fuel and associated costs in the late 1970s caused a sharp drop in returns and rising interest rates added to the financial problems of vessel owners. In addition, the introduction of larger vessels with increased engine power and more sophisticated fishing equipment was accompanied by declining catch per unit of fishing effort in a number of major fisheries.

Australian fishermen face foreign competition in all their major markets. Much of the output of Australian fisheries is exported to Japan, Europe and North America in competition with products of other fishing nations. On the domestic market, the Australian fishing industry faces competition from imports which are admitted largely free of duty. Thus, over the longer term, seafood prices are heavily influenced by supply and demand on world markets and the industry faces a continuing challenge to ensure that its economic efficiency does not decline relative to its major competitors.

Most of the decisions on catching, processing and marketing are taken on a private basis with a view to achieving maximum profit. However, governments in Australia are involved in such areas as product inspection and management of the catching sector. Measures such as gear restrictions, limited licensing and maximum vessel sizes are used to achieve a number of objectives, ranging from stock conservation to the protection of traditional ways of life.

Continued increases in fishing costs and declines in the rate of growth of revenue could result in pressure for increasing government intervention in the management of Australia's fish resources. In the remainder of this paper, the institutional arrangements for managing the AFZ and some important issues in the management of specific Australian fisheries are outlined.

2. MANAGEMENT OF THE AUSTRALIAN FISHING ZONE

Jurisdiction over waters surrounding Australia is shared by the Australian Government, six State Governments and the Government of the Northern Territory. State-Government jurisdiction applies in coastal waters up to three miles from the coast. The Australian Government exercises fishery jurisdiction over Australian vessels in proclaimed waters extending from the outer edge of coastal waters to 200 nautical miles, and over foreign vessels in the AFZ. Where the AFZ overlaps another country's 200-mile zone, it is delimited by agreed boundaries.

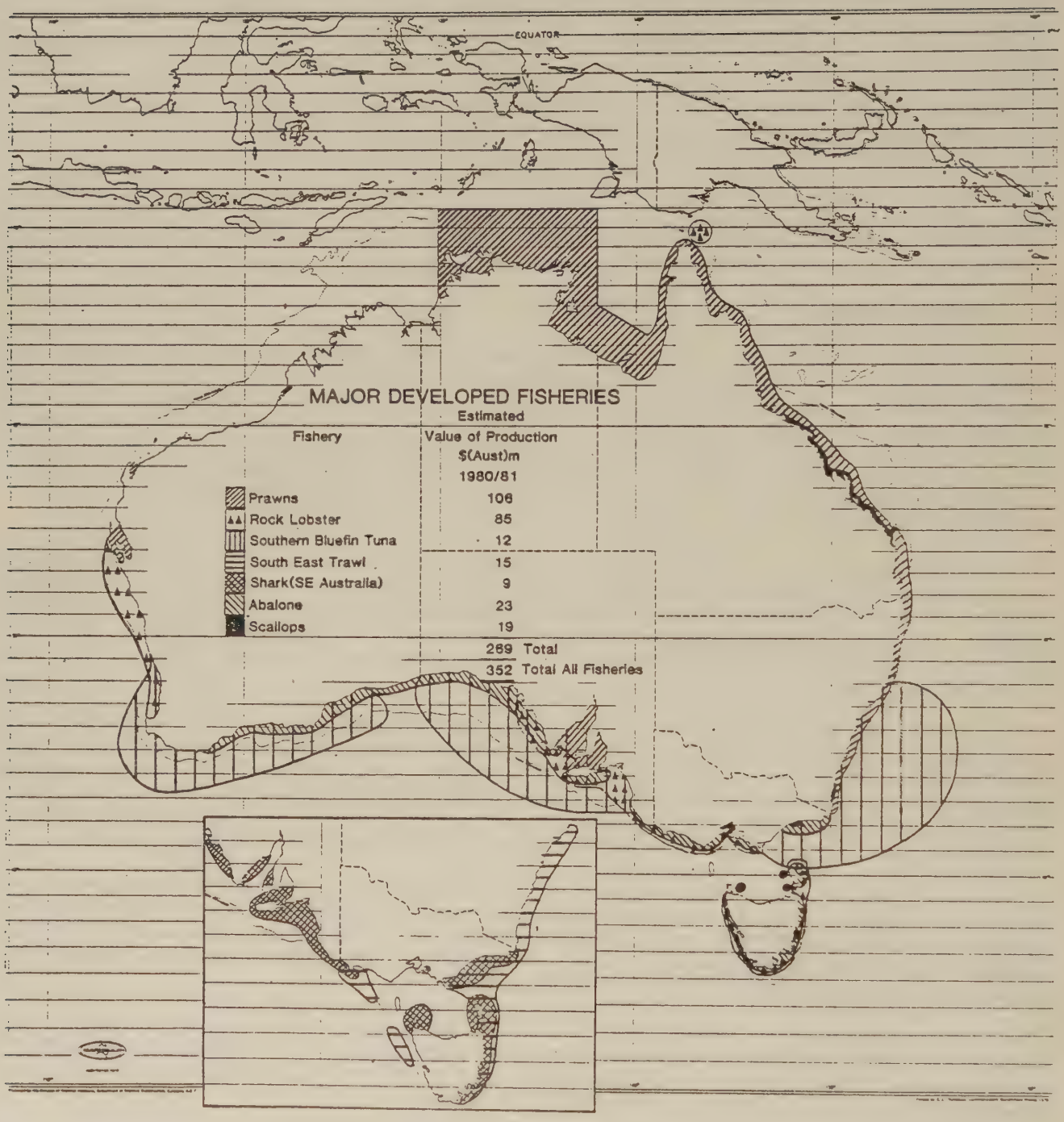

EQUATOR
MAJOR DEVELOPED FISHERIES
Estimated
Fishery
Value of Production
$(Aust)m
1980/81
Prawns 106
Rock Lobster 85
Southern Bluefin Tuna 12
South East Trawl 15
Shark(SE Australia) 9
Abalone 23
Scallops 19
269 Total
352 Total All Fisheries

Figure 1

The objectives of the Australian Government in the administration of fisheries within its jurisdiction are:

- Conservation and management of fish resources to ensure that they are not endangered by over-exploitation, and

- Optimum use of the living resources of the AFZ.

State Governments share these objectives. The stated aims of State fisheries legislation also include the development of fisheries and the fishing industry and, in some cases, the promotion of the industry and/or the welfare of its participants.

The development of the fishing industry is not generally regarded by Governments in Australia as one of the principal means to achieve regional economic development, although in the Northern Territory and Tasmania the role of fisheries in economic development is given greater emphasis. However, all State Governments and the Government of the Northern Territory recognize the fishing industry as an important source of employment and income in some areas. Where local or regional concerns about employment and income conflict with national concerns about stock conservation and optimum resource use, the objectives of the Australian Government and State Governments do not always coincide. However, as most Australian fisheries have been developed relatively recently, policy makers are not faced with the major problems of restructuring traditional or artisanal fisheries which are common in many other parts of the world.

Consultative mechanisms play an important role in the management and development of Australian fisheries. The Australian Fisheries Council (AFC) provides a forum for consultation between the Federal and State Ministers responsible for fisheries, on all aspects of fisheries, and the fishing industry. The AFC is serviced by the Standing Committee on Fisheries (SCF) which comprises senior fisheries officials. The SCF is serviced by a number of committees which are largely organized on a regional or species basis and comprise government and industry representatives. The Australian Fishing Industry Council, a voluntary national industry organization, also advises the Australian Government on major issues.

Jurisdiction over the AFZ may be modified when recently enacted legislation for the Offshore Constitutional Settlement is proclaimed. The Settlement provides that the Australian and State Governments may enter into agreements on the management of specific fisheries, to be implemented by joint Australian and State fisheries management authorities or by the Australian Government alone or one State Government acting alone. Implementation of agreements envisaged in the Settlement should permit some rationalization of both consultative procedures and the administration of fisheries management programmes.

3. SOME ISSUES IN LIMITED LICENSING IN AUSTRALIAN FISHERIES

The objectives of fisheries management can be defined as follows:

- conservation and development of living marine resources,

- promotion of efficient catching, processing and marketing, and

- equitable treatment of fishermen and other claimants on marine resources.

Conservation and economic efficiency can be achieved by controlling catch directly, or indirectly by regulating fishing effort.

Licensing and gear control is used extensively in Australia to control fishing effort. Licensing of fishermen, vessels and gear is frequently insufficient to control effort. In fact the introduction of a limited-entry management regime within a fishery frequently encourages rapid upgrading of vessels and fishing equipment because it is regarded as providing greater security of tenure. Financial institutions are much more inclined to lend to fishermen with exclusive rights in specific fisheries.

Controls on mesh size and gear design and on vessel replacement and restrictions on vessel length and engine horsepower have been used to supplement limited licensing in Australia. Closed areas and seasons have also been used. Supplementary controls have only proved to be partially effective in restraining effort, and vessel-replacement policies have adversely affected efficiency in some areas. However, the use of supplementary input controls has coincided with improved profitability in some fisheries, and the schemes in operation have been relatively inexpensive to administer.

In order to achieve stock conservation and efficient harvesting, it may be necessary in the future to reduce the numbers of vessels or gear units when a limited licensing scheme is introduced. Improvements in the availability and use of technology can be expected to necessitate further reductions over time. The number of fishermen, gear and vessels in a fishery may be reduced by means of policies of persuasion, retirement without replacement or buy-back. Of these, persuasion may be ineffective and retirement without replacement is unlikely to achieve a rapid reduction in effort. Buy-back has been discussed in the context of several Australian fisheries but is only being implemented in one, the barramundi fishery in the Northern Territory. The choice of fishermen to be retired may be controversial, whether selection is made by administrative or market means. Funding buy-back schemes presents further problems.

Where limited licensing is introduced, fisheries managers have the option of allocating licences to existing participants in the fishery, to 'bona fide' fishermen in general or to any individual or company with appropriate attributes. Generally, Governments in Australia have given first preference to existing participants in the fishery. However, there is a need to encourage the entry of potentially efficient operators with entrepreneurial skills and financial backing. It is also necessary to facilitate retirement from fishing owing to age or changing economic circumstances. In most fisheries, unrestricted licence transfers have been permitted to facilitate entry to and exit from the fishery.

If the issue or transfer of licences is restricted to one per bona fide fisherman, these fishermen are likely to be vulnerable to fluctuations in fish prices and fishing costs. If fishermen are allowed to hold licences in different fisheries or to have business interests other than fishing, their incomes are likely to be more stable and their effort in one fishery can be reduced if necessary without reducing their income excessively. In addition, holding licences for more than one fishery may be required to allow the exploitation of seasonal fisheries without enforcing extended idle periods for vessels. Although there have been concerns about a concentration of licence ownership in some fisheries, licensed fishermen are allowed multiple holdings of vessel licences and diversified business interests in most Australian fisheries.

The value of transferable licences in a limited entry fishery reflects the estimated present value of the expected future stream of net returns to fishing. Thus a transferable licence can be a valuable capital asset. It has been claimed that it is inequitable for licence holders to receive the full value of a licence at sale. However, fishermen argue that a fish resource has no value until a commercial fishery is developed and that fishermen who develop a fishery should earn at least a share of any profits. Substantial licence fees are levied in some limited-entry fisheries in Australia and they are making a significant contribution to the expenses of fisheries management.

4. DOMESTIC FISHERIES

Seventy percent of Australian fisheries are covered by limited licensing. Six fisheries have been chosen to illustrate the variety of experience of fisheries management in Australia. In four of them, the western rock lobster, the Spencer Gulf prawn, the northern prawn and the south-east abalone fisheries, there are established limited licensing schemes. In the south-east trawl fishery and the southern bluefin tuna fishery, management schemes are under consideration.

4.1 The Western Rock Lobster Fishery

The western rock lobster fishery is one of Australia's most valuable fisheries. It is also of particular interest, because there is a long history of gear control and vessel licensing in the fishery.

4.1.1 The Fishery

The western rock lobster lives in shallow coastal rock beds for the first four to five years of its life. At the end of this period, juveniles are reaching maturity and are about the legal minimum size for harvesting. In mid-November they commence migration to deeper water. The fishing season lasts until the end of June of the following year.

The commercial fishery extends along 1,000 km of the western Australian coastline from Shark Bay to Cape Naturaliste. The fishery is exploited by about 800 vessels, mostly between 7.5 and 13.5 m, employing about 1,800 men. Over half of the fishing fleet is concentrated in the ports of Geraldton and Fremantle. Developments in the fishery are an important influence on the welfare of the population of these towns. Much of the rest of the fleet is highly dispersed and many small communities are dependent on the fishery to a high degree.

In 1981/82, landings were about 11,000 tonnes, valued at more than A$60 million. The majority of the catch is processed for export to the United States, where Australia currently supplies about 40 percent of the market. The annual total catch in the fishery has been relatively stable for the last 20 years and, if this trend continues, the outlook for the participants in the fishery is good. The major influence on the economic performance of the fishery is the export market price. In real terms, the unit price received by Australian fishermen was stable over the period 1967-80 and is now about A$7 per kg. The continuing high price of the product has encouraged new entrants into the industry. The current market price for a licence to fish is in excess of A$2,000 per pot, with most fishermen operating between 75 and 100 pots. This reflects the high value of access to the rock lobster resources.

4.1.2 Management of the Fishery

After a rapid expansion in the fishery in the early 1950s, between 1955-56 and 1961-62, the total catch increased by only 8 percent, whereas the number of lobster pots in use increased by 60 percent. Consequently, concern arose about stock conservation and the long-run economic prospects of the industry.

To conserve rock lobster stocks, the legal minimum size at first capture was regulated and restrictions on pot design and closed seasons were introduced. In 1963, limited licensing was introduced and the number of pots per vessel was restricted. Subsequently, the total number of pots in the fishery was frozen at 76,000 and the replacement of vessels was controlled. The implementation of these and other management measures was facilitated by the coordination of industry attitudes and Government policy through a Rock Lobster Industry Advisory Committee, established by the Western Australian Government.

The management of the western rock lobster fishery has been successful in many respects. Stocks have been conserved by gear control and seasonal closures, total catch has been maintained over a long period of time and the excessive entry of vessels has been prevented. Close cooperation between industry and Government has been established. The welfare of fishermen and the standard of living in many communities dependent on the fishery has been maintained, although depressed conditions in international markets have resulted in periods of economic hardship. The licensing programme is relatively simple and inexpensive.

However, there have been difficulties in adapting the management system to deal with technological improvements. Despite restrictions on vessel replacement, the size and speed of fishing vessels has increased, permitting the number of fishing days to rise. Although the total number of pots in use has been restricted, the use of echo sounders to improve pot placement has further contributed to increased fishing effort. The fishing season was reduced by a further six weeks in 1977, to ensure conservation of the stock.

The reduction in the fishing season has increased the annual idle period for the industry. The number of vessels in the industry is greater than that which would be required to harvest the sustainable catch over a longer season. In the event of further increases in the efficiency of fishing vessels, the managers of the fishery will need to consider whether a further reduction in the season is compatible with continued industry profitability. Alternatively, controls on vessel size and inputs, reductions in pot numbers and a vessel buy-back could be considered.

4.2 The Spencer Gulf Prawn Fishery

The objectives of management in this State-controlled fishery are primarily based on economic considerations. The fishery is based on the exploitation of a highly valued species and potential gains from good management are substantial. The fishery has been subjected to limited entry virtually from the start and the effects of management can be studied relatively easily.

4.2.1 The Fishery

The fishery is located in the Spencer Gulf, an area estimated to exceed 16,000 square kilometres, in South Australia. A single species of penaeid prawn is exploited and fishing is concentrated on grounds adjacent to nursery areas.

The output of the fishery fluctuates but the long-term trend is stable at about 2,000 tonnes per annum. The output was valued at A$18.5 million in 1980/81. The economic performance of the fishery is good, as demonstrated by the value of licences which is believed to exceed A$200,000.

4.2.2 Management of the Fishery

Although the fishery is not vulnerable to over-fishing, seasonal area closures were imposed at the outset, to prevent excessive fishing on and near nursery grounds.

Since the commencement of the fishery, both Government and industry have been conscious of the need to prevent excessive entry from dissipating returns. Initially the issue of licences to fish was restricted to bona fide fishermen with a history of participation in the fishery and with adequate vessels. The number of vessel licences has been frozen at 39 since 1974/75.

Despite the freeze on vessel licences and associated controls on vessel length and subsequently on engine horsepower, there have been further increases in fishing effort. These increases have arisen partly from increased fishing time, owing to the use of stabilizers and the employment of relief skippers, and partly from the introduction of more powerful vessel engines and double- rigged trawls. It is estimated that fishing effort in the Spencer Gulf fishery rose by 50 percent between 1970 and 1978 and most of the increase resulted from the increased fishing time and fishing power of vessels.

Extensions of the closed seasons and areas have been imposed to restrict increases in effort. These closures are not an ideal method of restricting effort, because of the associated reduction in vessel fishing time. However, returns to fishing have remained relatively high, which indicates that limited licensing and associated input controls have assisted in maintaining industry profitability.

Licences to fish are not transferable in theory but in practice transfers have been allowed to occur without Government intervention. After discussions between Government and industry, licence fees were increased substantially, in recognition of the value of access to the resource, and are currently in excess of A$7,000 per annum. Although these fees are intended to fund research and development, they could also contribute funds for a future vessel buy-back programme, if such a programme was deemed to be desirable and feasible.

4.3 The Northern Prawn Fishery

The northern prawn fishery is one of Australia's most valuable fisheries. The development of a management regime for the fishery illustrates some of the hazards of management by limited licensing.

4.3.1 The Fishery

The northern prawn fishery extends across the northern coast of Australia from Cape York to near the border of Western Australia and the Northern Territory, and includes the Gulf of Carpentaria. The major species caught in the fishery are banana prawns and tiger prawns. Although the stock of banana prawns is not thought to be endangered, the declining length of the fishing season suggests that

effort is in excess of the amount needed to take the current catch. Tiger prawns and related species comprised an increasing proportion of the total catch in recent years. It is not possible to determine whether further increases in catch of these species can be sustained.

The total number of vessels permitted to operate in the fishery doubled between 1971 and 1980 and is currently 292. There was a rapid increase in the number of freezer trawlers over 21 m in length. The number of persons employed on vessels in the fishery is about 1,200.

During the early development of the fishery, Governments viewed it as a means of stimulating economic development and employment in northern Australia. However, shore-based processing establishments on the northern coastline have experienced difficulty in overcoming logistical problems and high operating costs in remote areas. A substantial proportion of the fish landings are transported by road and sea to plants elsewhere in Australia for processing, while an increasing proportion is processed on board the larger trawlers.

The total catch in the fishery rose from an average of 7,249 tonnes in 1969/71 to an average of 11,049 tonnes in 1978/80. Most of the catch was exported. Despite continued increases in the size of vessels and the efficiency of gear, catches have not risen commensurately with fishing effort. Many operators experienced financial difficulties in the late 1970s and early 1980s. These difficulties are reflected in the value of transferable vessel licences which have declined well below their peak value of about A$150,000.

4.3.2 Management of the Fishery

Early attempts at management were confined to seasonal closures, directed at reducing the catch of small prawns. These closures were intended to preserve the unit value of the catch rather than to conserve stocks. Closures are still applied.

Subsequently, a working group set up by the Northern Fisheries Committee (NFC), a body comprising representatives of concerned Government departments, recommended that a limited- entry policy be introduced to ensure stock conservation and promote industry efficiency. A freeze on vessel licences, together with a one-to-one equivalent vessel replacement policy, was introduced, pending the preparation of a comprehensive management plan.

A number of constraints impeded the introduction of a management plan capable of meeting Government and industry objectives:

- There was insufficient data to permit a generally acceptable estimate of the maximum effort which could be exerted on the several stocks in the fishery.

- After limited licensing was introduced, further effort control was required to ensure that the licensed fleet would not be progressively upgraded, resulting in over-capacity in the fishery. A vessel replacement policy, based on transferable units of underdeck tonnage, was proposed. However, industry maintained that the appropriate amount of effort was a commercial decision and that Governments should not intervene.

- The introduction of larger, more efficient company-owned vessels implied that, to maintain effort at an acceptable amount, the number of vessels leaving the fishery ought to exceed the number being introduced. However, any reduction in the number of smaller vessels could be seen to be supporting the interest of large companies, vis-a-vis, owner operators, and could conflict with Government objectives regarding employment and incomes in fishing communities in remote areas. The incentive for intervention by Governments was further weakened by the generally high returns being received by the industry at the time when the draft management plan was put forward.

The expectation that a tighter boat replacement policy would be introduced, together with a shipbuilding bounty on boats of over 21 m, provided incentives for an accelerated introduction of larger vessels in the northern prawn fishery.

Many owner operators sold their vessels and fishing licences to large companies, returned to Queensland and bought new vessels to use in the Queensland east- coast trawl fishery. The companies replaced the original boats with larger vessels and sold the smaller vessels to other Queensland fishermen. Consequently, there has been a rapid increase in effort in the Queensland east- coast trawl fishery which is causing management problems. These problems underline the need to coordinate fisheries management programmes in overlapping ecological or economic environments.

The entire management plan for the northern prawn fishery is currently under review. The earlier proposals to divide the fishery and to introduce a vessel-replacement policy based on underdeck tonnes have been revised. Division of the fishery is not widely supported but it seems clear that, if fishing effort is to be contained, the vessel replacement policy will need to be revised.

4.4 South-Eastern Trawl Fishery

The south-east trawl fishery is a multi-species fishery operating in a complex biological, economic and political environment. The fishery illustrates some characteristic problems in establishing a management regime for a multi-species fishery.

4.4.1 The Fishery

The principal area of this demersal fishery extends from Port Stephens along the central and southern coasts of New South Wales and eastern Victoria. The principal species are gemfish, redfish, flathead and morwong. Seasonal catches are obtained off western Victoria and north-western Tasmania. The width of the continental shelf, the condition of the sea bottom and the composition of the catch vary considerably over this area. A large proportion of the catch is taken from the deeper waters of the outer continental shelf and continental slope.

Some stocks, including flathead and morwong, are thought to be fully exploited, while others which occur in deeper waters further from shore, especially blue grenadier, are under-exploited. The maximum sustainable yield has been estimated at 25,000-35,000 tonnes but recent catches of lightly-exploited fishes such as blue grenadier, ribbonfish and orange roughy indicate that it could be higher.

About 180 vessels, employing 400 men, operate in the fishery. The average vessel size is 15-20 m in length. In recent years, vessels of over 20 m have become increasingly common. The vessels employ either otter trawl or Danish seine, though the proportion of Danish seiners is declining.

The south-eastern trawl fishery has an annual output of approximately 18,000 tonnes, valued at A$17 million. Most of the product is sold locally; the fishery is the principal source of Australian-caught fish sold through the Sydney and Melbourne fish markets. Some school whiting is exported, mostly to Japan. Most of the product faces competition from imports.

Economic performance in the fishery varies by area and by type of fishing vessel. Danish seiners and otter trawlers under 18 m in length yield relatively low returns, whereas larger otter trawlers perform relatively well. The profitability of the fishery has fallen in recent years, owing to increases in costs, particularly the cost of fuel. Further development of the fishery may occur through the increased exploitation of under-exploited stocks in deeper waters. The main influence on industry revenues is expected to continue to be the domestic price of finfish. This in turn is principally determined by domestic supplies and the price of imports. In the longer term, changes in consumer tastes and developments in marketing arrangements may have a major impact on this fishery.

4.2.2 Management of the Fishery

The south-eastern trawl fishery is relatively lightly regulated. The number of vessels over 32 m permitted to operate in the fishery is limited to four. There are also regulations on the minimum length of some species of fish at first capture and on the minimum mesh size of trawl nets.

The relative lack of regulation has not resulted in over-exploitation of the stocks in the past. In periods of economic downturn, some vessels have moved to other fisheries. However, because of increasing effort in alternative fisheries, the options for switching effort are diminishing. There is

also continuing concern that operators may upgrade their vessels, in order to improve their competitive position, without bringing about any improvement in the aggregate economic performance of the fishery. Consequently, serious thought is being given to an appropriate management regime.

The particular problems in the design of a management programme arise from the variety of exploitation of the stocks and the seasonality of fishing. Broadly speaking, the fishery can be divided into a traditional fully-exploited sector and an under-exploited offshore sector. Some seasonal movement from the developing to the traditional sector is needed to underpin the economic operation of vessels in the developing sector. The vessels required in the offshore sector are larger than those operating in the fully-exploited sector. This implies that, to achieve stock conservation and efficient harvesting throughout the fishery, the average size of vessels in the fully-exploited part of the fishery should be allowed to increase and the number of vessels should be reduced.

In these circumstances, there appears to be no ideal system of management. Mesh regulations and input controls, such as the regulation of tonnage or engine horsepower, are not flexible enough to achieve stock conservation and efficient harvesting of fish of mixed species and sizes, at different depths and in varying conditions. A system of vessel catch quotas would allow a precise approach to stock conservation but would be complex and expensive to enforce. The managers of this fishery may have to consider management measures which sacrifice some degree of efficiency and equity to gain simplicity and acceptability from a conservation viewpoint.

4.5 The South-Eastern Abalone Fishery

This fishery is of particular interest because Australia provides a substantial proportion of world output and, therefore, the level of production greatly influences international market prices.

4.5.1 The Fishery

The fishery is situated in coastal waters of New South Wales, Tasmania, Victoria and South Australia. The predominant species are black lip abalone and green lip abalone. The stocks have some degree of natural protection from over-exploitation. Juvenile abalone are secretive, avoid light and are hard to find. Adults are distributed over a wide area and exploitation is limited to areas where diving is safe. Although the most abundant year class in the overall catch is the one immediately above legal minimum length, which indicates a high fishing pressure, stocks are not believed to be over-exploited.

Currently, approximately 600 divers and crewmen participate in the fisheries. Divers harvest abalone by prising them from the rocks. The divers use relatively small vessels of 5-7 m as platforms. These vessels are fast through the water and easy to transport by road. After landing, the catch is processed locally and nearly all of it is exported, principally to Japan and Hong Kong. Exports are equally divided between canned and frozen products.

The fishery developed rapidly from the early 1960s to produce about 6,700 tonnes , worth A$37 million in 1980/81. Australia produces about one-third of the total world abalone catch. The trend of economic performance of the fishery has been relatively good. The cost of a vessel and diving equipment are relatively low, while the unit value of abalone landings in Australia was about A$3.50/kg in 1981. In general, the economic prospects of the abalone industry in south-east Australia are good. The chief problem is periodic over-supply in key export markets, especially Japan. However, being a leading producer and Japan's major supplier of imports, Australian producers can influence prices if they regulate supply.

4.5.2 Management of the Fishery

It is prohibited to take abalone from waters outside the 3-mile territorial limit adjacent to Tasmania, Victoria and South Australia. There are regulations on minimum lengths at harvest in coastal waters adjacent to all concerned States. These lengths vary between 102-103 mm. In addition, all States control the entry of divers into the fishery by limited licensing. These measures have been successful in maintaining stocks and industry profitability. There is little scope to improve the technology of abalone diving by labour-saving devices.

The major problem in the abalone fishery is likely to continue to be control of production to prevent excessive fluctuations in price. Changing the number of licensed fishermen is not an appropriate method of achieving such fine tuning.

As mentioned above, Australian abalone producers are in the fortunate position of being able to exercise some control over international prices. In 1982, a major build-up of stocks in Australia occurred, owing to depressed markets in Japan and elsewhere. Following consultations between industry and concerned Government authorities, abalone divers voluntarily restrained production to allow stocks to clear and to minimize further reductions in prices. Processors gave divers some financial assistance in the belief that they would gain more from higher prices than they would lose from payments to divers. The action of abalone divers and processors demonstrates the potential value of industry self-regulation. However, voluntary restraint can only be expected in Australia where relatively small groups of fishermen are involved and collective action can be confidently expected to achieve substantial gains.

4.6 The Southern Bluefin Tuna Fishery

The southern bluefin tuna (SBT) is a highly migratory species with special management problems. It is the only international fishery in which Australia is a major participant.

4.6.1 The Fishery

SBT is a migratory species which spawns between Java and north-western Australia. Juveniles migrate down the west coast of Australia and most of them follow the Australian coast eastwards before migrating eastwards into the Pacific chiefly in a band between 40^{o} and 50^{o} S.

In recent years, up to 50 percent of the global catch of SBT has been taken in the AFZ, with the remainder being caught in the southern ocean from New Zealand to South Africa. The stock is exploited extensively by Japanese distant-water longliners.

The Japanese catch peaked at 70,000 tonnes per annum in the 1960s and has subsequently fallen to about 28,000 tonnes, of which about 10 percent is taken in the Australian fishing zone. New Zealand has a small but growing SBT fishery; currently the total catch is several hundred tonnes.

After the initial development of the Australian tuna fishery in the 1950s, catches were relatively stable between 6,000 and 14,000 tonnes in the period 1960-80, with fishing concentrated off south-eastern Australia. In the last two fishing seasons, there has been a marked increase in production and total Australian production was 21,585 tonnes, valued at A$35 million, in 1981/82. Although much of the product is consumed in Australia, the quantity of exports, which fluctuates according to demand in export markets, has reached several thousand tonnes.

The composition of the Australian tuna fleet varies from State to State. In western Australia, there are now up to 100 vessels of 8-14 m engaged in seasonal pole-and-lining for tuna of 2 to 3 years in age.

In South Australia and New South Wales, there are now about 55 vessels, averaging over 22 m in length and fishing for tuna of 3 to 6 years of age. Most of the vessels are pole-and-liners, although there are five purse seine vessels. Some vessels only fish seasonally for SBT and operate in the south-eastern trawl fishery for the rest of the year. Port Lincoln in South Australia is the major port for the fleet. There are important onshore processing facilities at Port Lincoln, at Eden in new South Wales and in Western Australia.

The economic performance of the Australian tuna industry has been generally satisfactory, although price fluctuations and high interest rates at a time of rising costs created difficulties for some vessel owners in 1982. However, fishing power has been expanding considerably more rapidly than catch, indicating increasing over-capacity in the industry.

4.6.2 Management of the Fishery

Recent developments in the management of SBT have been prefaced by two important legal and institutional developments. Article 64 of the Law of the Sea convention directs States concerned in the exploitation of highly migratory species to:

> "Cooperate directly or through appropriate international institutions with a view to ensuring conservation and promoting the objective of optimum utilization of such species throughout the region, both within and beyond the exclusive economic zone."

The declaration of the Australian fishing zone in 1979 was accompanied by an agreement between the Australian Government, Northern Territory Government, State Governments and industry that foreign fishing inside the AFZ would only be permitted where Australian fishermen could not harvest the optimum catch. The recent expansion in Australian fishing effort can be partly attributed to an expectation that foreign fishing in the zone would be phased out if local industry demonstrated its capacity to harvest the available resources.

When the zone was declared, a freeze on vessel licences for the tuna fishery in south-eastern Australia was in force. This licence limitation, which placed no restriction on the size of replacement vessels, was ineffective in restraining vessel improvements in the south-east Australian tuna fleet. The number of vessels in the West Australian fishery was not restricted. Furthermore, industry argued that it was contrary to the agreed policy for managing the AFZ to limit Australian licences to fish SBT while Japanese vessels were catching SBT in the AFZ. Consequently, the freeze on vessel licences was removed in April 1981.

To protect the interests of the growing Australian tuna industry, the permitted areas of operation and fishing season of Japanese fishermen in the Australian fishing zone have been progressively reduced since the Australia/Japan Fisheries Agreement was signed in 1979.

Recently, scientists of the Commonwealth Scientific and Industrial Research Organization (CSIRO) concluded that SBT stocks were in some danger of collapse with the passage of time, if effort was sustained at current levels. The Australian Government is considering the introduction of a management regime in the fishery.

As a first step towards international management, the Governments of Australia and Japan have agreed to actively consider the international management of SBT as a means of conserving the resource. The first discussion on SBT management between Australia, Japan and New Zealand took place on 13-17 December 1982 in New Zealand. Effort control by means of an international vessel licensing system is unlikely to be feasible because of differences in national law and custom. One potential solution to the management problem is the negotiation of a set of national quotas. Each country could then administer its own input or output control system, bearing in mind any limitations on the fishing seasons, fishing areas and the use of gear included in any international agreement for the purpose of stock conservation.

5. FOREIGN FISHING

The Law of the Sea Convention directs Australia, as a coastal State, to permit access to the AFZ by foreign vessels to fish for any resources surplus to Australian harvesting capacity. The Convention also grants Australia the right to take account of all relevant factors, including the significance of the living resources of the zone to the economy of Australia and its other national interests. The principal policy objective in considering joint Australian foreign fishing arrangements is the maximization of Australian ownership of and/or participation in harvesting, processing and marketing in the fishery.

Joint fishing arrangements are confined to fisheries which are not yet adequately developed by Australian fishermen. If arrangements are approved, foreign fishing in the AFZ is subject to a number of regulations, including reporting requirements and arrangements for the accommodation of observers and the provision of data. Joint fishing arrangements may take these forms.

Joint feasibility fishing arrangements provide a fast and inexpensive method of resource assessment for species which are not fished or very lightly fished by Australians, and assist in conserving and in managing resources in accordance with international obligations. Licences are granted to foreign vessels to engage in feasibility fishing for periods of not more than two years. There have been no restrictions on the catches of vessels engaged in such fishing and no fees have been charged. When resources have been proved by feasibility fishing or stock assessment research, foreign fishing may be permitted under joint ventures or bilateral agreements if the resource is surplus to Australian harvesting capacity.

There have been a large number of feasibility fishing projects which have confirmed the limited extent of commercial fisheries around Australia. However, a large squid resource in south-eastern waters was identified.

Joint ventures are longer-term commercial propositions which offer benefits to Australia by mobilizing foreign capital, vessels, crews and expertise to develop new fisheries. Joint-venture proposals receive preference over proposals for bilateral fishing because they encourage the development of fishing by Australians.

Stock conservation is facilitated by assigning catch quotas to foreign vessels and by restricting their permitted fishing season and area of operation. Joint-venture companies are liable to pay fees based on a percentage of the market value of the catch. These fees contribute to the expense of surveillance and administration of the AFZ. Fees may be waived in recognition of benefits received from the joint-venture company. The interest of the local shipbuilding industry is protected by controls on the importation of foreign vessels. Finally, to prevent excessive export of company profits, joint venture companies are obliged to ensure that Australians hold majority shareholdings and voting rights.

Joint fishing operations undertaken in Australia to date, include pearl culture, prawn fishing in northern waters and a trawling venture in the Great Australian Bight. The pearl-culture and prawn fishing ventures proved commercially successful and subsequently foreign vessels have been phased out.

If Australian fishermen cannot harvest resources and there are no joint venture proposals which are acceptable to State Governments and the Australian fishing industry, bilateral fishing arrangements may be approved under which foreign fishermen are granted access to the Australian fishing zone, subject to the payment of a fee based on a percentage of the market value of the authorized catch and compliance with Australian regulations relating to foreign fishing. If these regulations are breached, further fishing licences may be refused. Bilateral agreements are subject to annual renewal which allows the Australian Government to reduce or withdraw quotas and restrict areas if Australians wish to enter the fishery and/or viable joint-venture proposals have been received.

Prior to the introduction of the AFZ, the only foreign vessels fishing around Australia in substantial numbers were Japanese tuna-longliners and Taiwanese pair-trawlers and gillnetters. In order to ensure that these operations were subject to controls under Australia's extended jurisdiction, fisheries' agreements were signed with Japan and with Taiwanese commercial interests in 1979 and have been renewed annually. The areas available for Japanese and Taiwanese bilateral fishing in 1981/82 are shown in Figure 2.

Discussions have recently commenced with the Republic of Korea concerning a bilateral squid-jigging agreement to fish in south-eastern waters of the AFZ.

6. CONCLUSIONS

The development of Australian fisheries is likely to be constrained in the 1980s by the limited extent of new fish resources, sluggish markets and continuing increases in fishing and transport costs. Improved fisheries management cannot solve these problems but they may be eased if Government objectives for fisheries management are met. These objectives include stock conservation, efficient exploitation of marine resources and stabilization of incomes in the fishing industry.

A wider variety of management measures have been used to achieve these objectives in Australian fisheries. Limited licensing of fishermen, fishing gear and vessels has been predominant among these measures and controls on the type of gear and vessels, fishing seasons and fishing areas have also been widely used.

Available information indicates that stocks are robust in most Australian fisheries, although there are problems in the southern bluefin tuna fishery and questions about some stocks, such as banana prawns, in fisheries where effort has increased rapidly in recent years. Limited licensing has not been sufficient to control fishing effort and prevent stock depletion. In most limited-entry fisheries additional controls have been required.

The success of management in achieving economic efficiency has been mixed. Limited entry has restricted over-capitalization arising from excess numbers of fishermen, gear and vessels. However, the increased security of operations in limited-entry fisheries has resulted in improved access to finance and encouraged the upgrading of vessels and equipment. Additional controls, including restrictions on mesh sizes, fishing areas and seasons, vessel length and tonnage, and engine horsepower have been required to prevent further increases in fishing effort in limited-entry fisheries.

These controls have often constrained increases in productivity, although in some fisheries, including the Spencer Gulf and northern prawn fisheries, restrictions on fishing areas and seasons and on mesh sizes have prevented the harvest of prawns before they reached acceptable market size and, consequently, enhanced yields and profits.

It has proved difficult to reduce the numbers of gear units and vessels used in fisheries or to introduce comprehensive input controls. These difficulties have been experienced in the western rock lobster and Spencer Gulf prawn fisheries. They are emphasized further by the history of the northern prawn fishery, which also illustrates the need to coordinate the management of different fisheries.

Turning to equity issues, Australian fishermen are sharing an increasing proportion of the cost of management in some limited-entry fisheries, notably the Spencer Gulf prawn fishery. In limited-entry fisheries, where licences are transferable, they may attract large transfer fees which in turn attract criticism on equity grounds. However, if licences are non-transferable, adjustment problems can arise and efficiency can be impaired, particularly where older fishermen feel unable to leave the fishery.

The introduction of limited entry in Australian fisheries has been accompanied by expectations that fishermen's incomes would increase. However, fishermen's incomes cannot be guaranteed in the face of fluctuating catches and prices. Furthermore, the impact of limited entry on fishermen's incomes depends not only on its success in promoting stock conservation and economic efficiency but also on the distribution of fishing licences in limited-entry fisheries. This raises several issues.

Restriction of licences to bona fide fishermen may protect the interests of existing fishermen but it could discourage efficiency by restricting the entry of entrepreneurial and financial resources. Restriction of licence holdings by any one individual or company may prevent concentration of licence holdings and consequent exploitation of fishermen. However, it may also prevent fishermen from diversifying their activities. Diversified fishing is necessary to allow the efficient exploitation of seasonal fisheries; it can add to fishermen's security and it may facilitate the adjustment of effort in individual fisheries if required.

Finally, limited licensing is inconvenient for licencees and expensive to administer in fisheries where there are several licensing authorities and multiple licensing is required. Several important fisheries in Australia cross State boundaries and licences are required from the Australian Government and concerned State Governments. Further complexities may arise in licensing for multi-species fisheries.

In view of the drawbacks of limited licensing, management options which use output quotas are being examined with increasing interest. Where fisheries are exploited by relatively small fleets and fish landing and processing is concentrated, as in the Australian SBT fishery, the costs of policing vessel catch quotas may be kept within reasonable limits.

In the remainder of the 1980s, there are several factors which are expected to encourage developments in fisheries management in Australia. There is a growing recognition of the potential

contribution of fisheries management to alleviating fishing industry problems. The Offshore Constitutional Settlement has provided an opportunity to rationalize consultative procedures and administrative arrangements for fisheries management. Finally, the experience of management in Australian fisheries is beginning to offer some insight into the relative merits of various options and industry and Governments are gaining a better understanding of the issues and limitations of fisheries management.

Figure 2

REGULATION OF FISHING EFFORT (FISHING MORTALITY) NEW ZEALAND

by

G. Duncan Waugh
Fisheries Research Centre
Ministry of Agriculture and Fisheries
Wellington, New Zealand

BACKGROUND

New Zealand's chain of islands extends from latitude 29- to 53- South. The nearest continental land mass, Australia, is about 1200 km to the west. The main islands have a narrow continental shelf, average width 19 km, extending down to a depth of about 200 m. The limited area of shelf, which nevertheless extends from subtropical to subantarctic waters, and the small population (less than 3 million) were the two main factors which determined the pattern and scale of fishing until the mid 1960s. Local demand for fish in a primarily agricultural society was small - less than 7 percent of the per capita intake of animal protein. Even in the 1930s there was concern that the resources could be overfished and as a result a limited entry system was introduced in the 1940s and remained in force until 1962.

In 1959 foreign vessels began fishing to within three miles of the coast. This suggested that the resources were larger and more readily saleable on the international market than had previously been recognized. Even so these vessels, like their local counterparts, concentrated on a few high-value species such as snapper (Chrysophrys auratus). In 1961 a Government Select Committee recommended delicensing of the fishing industry and a system of commercial fishing permits was introduced. Thus anyone, on payment of a nominal fee, had the right to catch and sell his catch commercially. His recreational counterpart, on the other hand, was prevented from selling his catch and there was a limit on the number of fish or shellfish he could have in his possession on any day. Inevitably there were conflicts of interest between the local and foreign vessels and crews with respect to fishing areas. Finally it was agreed that foreign fishing should be phased out to beyond 12 miles from the coast by 1974. In this same period the local industry began to develop, first slowly and then much more rapidly as major markets for finfish began to be developed. By 1949, even before the finfish markets developed, rock lobsters - primarily Jasus edwarsii - were being exported to the USA in quantity, and they continue to be the single most valuable species. Amongst the finfish, snapper was the most valuable until 1982 when its position was usurped by orange roughy (Hoplostethus atlanticus).

From 1963 to 1967 fisheries exports increased gradually, but from 1968 they increased rapidly while local markets remained virtually static (Table 1). Thus the industry underwent a change from one oriented primarily to local supply and demand with limited exports to one with the principal objective of earning overseas exchange. As these developments were taking place in the local industry foreign vessels were exploring further afield and fishing deeper on some of the undersea plateaus (see Fig. 1). This, coupled with the Law of the Sea (LOS) negotiations, led New Zealand to declare its own 200-mile Exclusive Economic Zone (EEZ) in 1978 (see Territorial Sea and Exclusive Economic Zone Act 1977). Under the terms of the draft convention and because of the presence of small offshore islands the zone encompasses some 1.18 million square nautical miles of ocean (Blezard, 1980). Apart from two minor jurisdictional boundaries between Australia and New Zealand, New Zealand is in the privileged position of having a virtually complete 200-mile zone for its exclusive management and administration.

However, there was and continues to be considerable uncertainty with respect to the magnitude of the resources. It was almost inevitable that the Government, impressed by the sheer size of the zone, should assume that almost unlimited quantitites of fish would be automatically available, and words of caution (Waugh, 1977) tended to go unheeded.

It was quite apparent that the coastal craft were incapable of exploiting the deeper offshore waters and few local fishermen had experience in the operations of deep-sea trawlers. At the same time there was vitually no information on the species and their abundance in the zone. Nevertheless the Government, having declared the EEZ, had, under the LOS, accepted the concomitant obligation to manage the zone and its resources.

It is the evaluation of the management strategies and measures and their impact on the local industry that is the main purpose of this paper.

Table 1 Value of New Zealand fishing exports (x $1 million) from 1963 to 1981

Year	Finfish	Rock Lobsters	Total All Products
1963	0.88	2.05	2.92
1964	1.10	3.04	4.15
1965	1.10	3.95	5.10
1966	1.22	4.62	5.88
1967	1.35	6.36	7.76
1968	1.69	12.73	14.63
1969	1.90	14.23	16.54
1970	4.40	12.43	17.33
1971	5.00	13.50	20.30
1972	6.79	11.62	20.40
1973	7.30	11.30	20.10
1974	7.31	11.42	20.33
1975	8.80	12.07	25.75
1976	14.75	19.05	37.88
1977	21.45	23.67	50.36
1978	32.13	25.40	63.63
1979	53.35	26.94	97.65
1980	85.87	29.48	162.44
1981	117.22	35.69	190.22

Fig 1: New Zealand's Exclusive Economic Zone, showing the management areas A to H and the areas closed to foreign fishing.

Figure 1

PLANNING AND REGULATION

The fisheries are administered under the Fisheries Act of 1908. Since then there have been a large number of amendments and regulations which have been intended to conserve resources, protect ethnic fishing rights, limit gear and so ensure a more equitable distribution of the resources amongst fishermen, etc. Most of these measures have been subject to the Parliamentary process and as such have been inordinately delayed. A new Bill, which has been widely discussed with industry and other user groups, has been drafted and could be passed into law during 1983. Basically, this Bill is designed to rationalise the provisions of the previous Act, to consolidate them, and to make it possible for managers to react much more swiftly to changing circumstances in the fishery.

After the abandonment of limited entry in 1962 the local industry began to expand, grants and loans were available for new vessels and new gear, and new markets were being developed. Export earnings began to increase (Table 1) so that by 1978 the overseas earnings were 22 times what they had been in 1963. However, even by 1978 there was some concern amongst the finfish and rock lobster fishermen that resources were being over-fished. In 1979 empowering legislation was introduced to permit the control of eel, dredge oyster, paua (= abalone), snapper, and rock lobster fishing. In the next few years a controlled fishery was established for eels in Lake Ellesmere, a system of daily boat quotas and an overall catch quota for the Foveaux Strait oyster fishery, an export quota for paua, quota and gear controls on the Hauraki Gulf snapper fishery, and a controlled fishery for rock lobsters based on a number of regions around the coast (Saila et al., 1979; Annala - in press).

These various controls, coupled with the collapse of the trevally fishery in the Bay of Plenty (Waugh, 1977a; James, 1980) and the decline in catches and mean size of prime species elsewhere, finally forced Government and fishermen to look to some further limitation on fishing effort. Since 1981 there has been a moratorium on the issue of any further fishing permits, the methods which may be used are more rigolously prescribed, and the fishermen are required to provide more detailed catch and effort data.

Unfortunately, in New Zealand, as in practically every country with a developed or developing fishery, vessel numbers and processing facilities were allowed to develop and multiply to a point where they could no longer be sustained by the available resources. There was a shift from prime species to exploitation of those of lesser value. This led to successive over-fishing of a number of species and could continue to do so unless total effort is reduced or there is a definite break in the species/fishery sequence.

Inevitably there will have to be some restructuring of the industry and new management concepts applied. However, because of what happened to the inshore fisheries there was an earlier and much readier acceptance that the resources of the wide EEZ could be equally liable to over-fishing and over-capitalisation. It was also recognised that more responsive management measures would be needed to obtain maximum benefit.

Thus there have been two types of fishery - inshore and offshore - developing slightly out of phase with each other, both aimed at increasing overseas earnings, at maximising New Zealand's share of the available resources, and at maximising local employment.

The principal differences that have emerged to date are that in the coastal fisheries there is very little room to manoeuvre - there are too many vessels trying to catch too few fish - but in the offshore fisheries there is room to rationalise fishing now, before it too gets out of hand.

EEZ planning and objectives

Prior to the declaration of the EEZ a small task force, comprising a senior fisheries scientist, a fishery manager, and an administrator, was established within the Ministry of Agriculture and Fisheries to develop objectives and strategies for the deep-water fisheries. Recommendations followed by others that embrace the general philosophy of utilising the resources were embodied in a Policy Paper which has since been modified and published as a definitive document (Anon., 1981) which defines the way of apportioning the known resources between vessels and between companies during the next few years. However, the lead up to this situation has not been straightforward.

There was little or no information on the size or species composition of the resources of the zone. The LOS requires that the Coastal state determines Total Allowable Catches (TACs) and determines what proportion it can harvest with its indigenous fishermen and vessels and then allocates the balance to those countries which have "traditionally" fished in the area. Few foreign trawlers had fished in the region beyond the immediate continental shelf before the early 1970s and so the question of traditional rights hardly arose. Tunas and billfishes had been exploited for much longer, but as highly migratory species they were treated separately.

RESOURCE ASSESSMENT AND ALLOCATION

Trawl fisheries

Because New Zealand lacked a suitably large and seaworthy deep-water craft, scientists attempting to assess resources were dependent upon data from other research cruises, primarily Japanese but also some Russian. Francis and Fisher (1979) made the first estimates of the overall magnitude of the resources. At the same time it was recognised that there were areas or regions in which particular associations of species occurred. Some of these last are associated with water masses north and south of the Subtropical Convergence and with the principal warm and cold currents which flow around the islands.

The net result was the establishment of eight management zones (A to H, Fig. 1) outside the 12-mile territorial sea. In the meantime, and before the zone was formally gazetted, intense fishing in critical areas, for ling off the south-west of the South Island and for silver warehou east of Stewart Island, meant that these two areas were closed to all fishing. Within 2 years most of the shelf was included in the 'New Zealand only' fishing zone (Fig. 1) as the local industry demonstrated its capacity to fully exploit the prime species.

New Zealand, though lacking the deep-water vessels and crews to fully exploit the resources, nevertheless wished to benefit as much as possible from the potential harvest. To achieve this there was encouragement by way of loans, waiving of customs duty, etc., to enable local industry to acquire larger vessels. However, none of these craft were sufficiently big to work on the offshore rises and plateaus. The alternative was to establish joint venture or cooperative venture arrangements with foreign partners. New Zealand generally requires that foreign equity will not exceed 24.9 percent, although in some instances 49.9 percent has been acceptable. In most cases the foreign partner has provided the vessel and most of the crew as well as some additional opportunity for access to new markets. Various structures were set up involving varying degrees of risk for the participants, but the net result was that the quantities of fish available to foreign licensed vessels was substantially reduced.

Francis and Fisher's (1979) estimate of the resources also indicated the bounds within which there could be a reasonable annual harvest. With so few data available it was considered reasonable to err on the conservative side in setting catch quotas. Allocation was made first to local vessels on the basis of their expected catch as assessed by the Fishing Industry Board and second to joint venture vessels on the basis of the fishing plans they were required to lodge. After both these allocations had been deducted from the TACs the balance was made available to foreign licensed vessels from Japan, the USSR and Korea. Apportionment between these countries was made at Government level and took into account previous fishing history, levels of cooperation, trade access, etc.

Joint ventures were seen as a way of accelerating New Zealand's participation in the capture and processing of as much as possible of the resource. However, they also meant that much larger quantities of fish were landed into processing plants and this was seen as a threat by local fishermen who foresaw a reduction in the prices paid to them. Both the fishermen and the processors were also concerned that species taken and processed by licensed vessels were being sold at reduced prices on some of New Zealands's traditional overseas markets.

One of the original aims was the progressive New Zealandisation of the industry so that ultimately all fish would be taken by locally owned and crewed vessels. In practice, although the joint venture vessels have a proportion of local fishermen aboard for training in appropriate fishing technology, the language and ethnic barriers preclude the gradual replacement of foreign crews by New Zealanders, particularly where the foreign partners continue to own the vessels. To resolve this problem nine companies with a percent greater than 75 percent New Zealand shareholding have been allocated varying quantities of the principal deep-sea species, up to the total estimated quota, as from 1 April 1983 (see Table 2). From that date the effective ownership of the fish will pass into New Zealand hands, although the companies may continue to use their joint venture partnership vessels on a charter basis. It is also worth noting that one local company has now made its own investment in two deep-water trawlers.

There continue to be very few quantitative data on the seasonal distribution and abundance of the different offshore species. When TACs were first assessed there was no consideration of the unit value of the various species. Thus southern blue whiting (Micromesistius australis), which is particularly abundant in area E, is of relatively low value and as such is unlikely to be of economic interest to a locally-based industry. Thus it has been necessary to consider the unit value as well as likely yields in apportioning quotas which can maintain the economics of the various operations.

Hake (Merluccius australis) only spawns off the west coast of the South Island and is then vulnerable to intensive fishing. The total stock appears to be small (Patchell, 1981). To prevent overfishing a quota system was introduced and when the quota was reached all trawling ceased until the remaining fish had dispersed. However, hoki (Macruronus novaezelandiae) occurs in the same area at the same time and is much more plentiful (Patchell - in press). This has meant that in order to protect the hake stock, the hoki resource has been underfished. Furthermore, the need for close monitoring created surveillance problems compounded by the conflict between locally owned and crewed vessels, which claimed to be able to harvest the total resource, and the joint venture charter vessels. Unless it becomes practical to target fish for the two species separately, which seems unlikely, the hoki stock will either continue to be underfished or the hake stock may have to be allowed to decline. This illustrates the manager's problem of conservation on the one hand and maximisation of earnings on the other. It also emphasises the need for more comprehensive quantitative and biological data on the species concerned.

In the past four years quotas have been established and are close to being reached for all the species assessed by Francis and Fisher (1979) except for the southern blue whiting in area E. Species not considered by them are the orange roughy (Hoplostethus atlanticus) and the various species of oreo dory, all of which occur in depths of 800 to 1,500 m and were located in 1979 and 1980 along the northern side of the Chatham Rise and off the east coast of the South Island. Licensed access for Russian trawlers is now restricted to area E. Japanese and Korean vessels have most of their allocations in the same area but are allowed limited access to primer species elsewhere.

The quota for orange roughy had to be established on very meagre information. The fish apparently occur in dense pre-spawning schools but little is known of their general biology or of their longevity. Thus again it was necessary to adopt what was hoped would be a conservative quota. Exploratory cruises in January and August 1981 along the edge of the Challenger Plateau from west of 172-E and between 37-S revealed significant quantities of orange roughy (van den Broek, 1981) both inside and outside the 200-mile boundary, and in the 1982 season substantial catches were made. Although this has been a further encouragement for investment in the deep-water fishery the basic problem of the size and resilience of the stock or stocks remains. Without their own research vessel capability, scientists have had to rely on opportunistic collection of data aboard commercial craft or occasional joint research cruises with Japanese institutes. However, in 1982 an additional quota of 1,000 t of orange roughy was offered by tender to a commercial company that was prepared to make one of its vessels available for a 42-day research cruise entailing stratified random sampling along the Chatham Rise (Robertson, 1982). The results obtained provide the first estimate of the standing stock along the Rise and it is hoped to undertake a similar survey on the Challenger Plateau in 1983.

From the foregoing it will be apparent that the management of the trawl fisheries of the wider EEZ has been based upon quotas and that these have had to be adjusted as more data have been acquired on the species themselves as well as on the economics of catching them.

Table 2 Allocations (tonnes) of prime species to take effect from 1 April 1983 (from Catch 1982, (9) 11

Species	Amaltal	Fletcher/ Jaybel	Sanford/ Feron
Hoki	3,336	8,947	8,231
Orange roughy	2,701	8,123	6,701
Oreo dories	1,701	5,117	4,221
Squid	1,652	4,429	4,074
Ling	661	1,772	1,630
Silver warehou	496	1,328	1,223
Hake	198	532	489
Total :	10,744	30,248	26,569

Species	Sealord	South Island Deep Sea Fishing Company	Skeggs	Southland Fish Processors Co-op	Wanganui
Hoki	8,136	1,405	3,486	722	1,729
Orange roughy	6,832	965	3,058	495	1,398
Oreo dories	4,304	608	1,927	312	881
Squid	4,028	696	1,726	358	856
Ling	1,611	278	690	143	342
Silver warehou	1,208	209	518	107	257
Hake	483	83	207	43	103
Total :	26,602	4,243	11,612	2,179	5,567

Species	Watties	Other	Total
Hoki	1,769	2,638	40,000
Orange roughy	869	1,559	32,700
Oreo dories	548	982	20,600
Squid	876	1,306	20,000
Ling	350	522	8,000
Silver warehou	263	392	6,000
Hake	105	157	2,400
Total :	4,780	7,556	130,100

Squid

Prior to the declaration of the EEZ, New Zealand fishermen took squid mainly as a by-catch. Japanese squid jig vessels had operated around New Zealand from 1972, and after 1978, as the technique was directed solely at squid, it was decided to restrict the number of licensed vessels to that which had previously fished the area. The intention was to prevent any further increase in effort. Licence fees are payable in advance and are based on an expected catch. The licence fee is based on the average catch over the preceding five years with a royalty on the catch over and above the base allocation. This management system seeks to prevent over-fishing in years of poor recruitment but to allow the vessels to benefit if recruitment is good. In practice it assumes that the few years of data that have been collected represent the norm and that there has not been, or is unlikely to be, any recruitment over-fishing.

New Zealand's entry to squid fishing has been via joint venture agreements and as the joint venture fleet has increased so licensed access has been abated. Jigging seems unlikely to be a significant local fishery in the short-term, but in the meantime the joint venture catches improve market access and provide product for onshore processing.

Trawled squid are the subject of area quotas for licensed joint venture and local vessels and until recently were based upon a single stock concept. However, the identification of at least two species of Nototodarus (Smith et al., 1981) suggests that future management will need to ensure that effort is appropriately distributed between them in relation to their abundance. It also illustrates the lack of basic data and the need for management to be flexible and able to respond to new research findings.

Tunas

Different management measures have been adopted for the highly migratory skipjack, albacore, and southern bluefin tunas. Skipjack occur off the North Island in large schools during summer (Fisheries Research Division, 1976; Habib et al., 1980, 1980a, 1980b, 1981) and the potential harvest is estimated at 24,000 t. In the mid 1970s the local purse seine fleet was incapable of taking such quantities and authority was given for local companies to enter into charter agreements for American super seiners. However, these vessels have been denied access within the 12-mile zone and in some other areas. As the fish often school close to the boundary and frequently inside it, combined catches by the local and charter fleet have seldom exceeded 10,000 t. Local political pressure has precluded the full harvest of the resource, yet there are insufficient other pelagic species to sustain a large local purse seine fleet for the balance of the year. Alternative fishing techniques such as pole and live bait fishing could increase the local component of the catch, provide alternative employment, and reduce effort on the traditional fisheries. This type of fishery could have even greater economic appeal if, as seems possible, the fish are of sufficiently high quality for sashimi.

The troll fishery for albacore has existed since the early 1970s (Roberts et al., 1972; Roberts, 1974, 1975, 1977) but has not yet become of major significance. Joint research studies undertaken by Japanese and New Zealand scientists suggest that this fishery could be further developed by vessels capable of fishing further offshore and trolling deeper. The potential harvest is estimated at 5,000-10,000 t and there are no major management constraints. The moratorium on fishing permits does not apply and may encourage diversification away from coastal trawl fisheries.

Southern bluefin tuna have been longlined south and east of New Zealand by the Japanese since the 1950s and in 1978 the size of the licensed fleet was limited to what it had been previously (i.e. 96 vessels) in order to prevent further increase in effort. Since 1979 a small but lucrative local handline fishery for adult bluefin has developed on the west coast of the South Island. The winter fishing season coincides with the trawl fishery for hake and hoki. The fish, if properly handled, can be marketed at sashimi grade and the Ministry of Agriculture and Fisheries, the Fishing Industry Board, and the Federation of Commercial Fishermen combined to train fishermen in appropriate techniques. Now only trained fishermen take the fish, which in 1981 and 1982 were landed into a refrigerated reefer vessel. It was also agreed that the annual catch should be limited to 5,000 fish. This limits the number of fishermen likely to enter the fishery and avoids any glut on the market. It is not considered a conservation measure in that the tonnage - about 300 t - is minor in relation to 40,000 t taken by Japan and Australia.

The total stock is already overfished (Murphy and Majkowski 1981) and it will be necessary for the three countries to develop management measures to limit the total catch. In the meantime New Zealand fishermen, having developed a fishery in a previously unexploited area, are anxious to increase their sphere of operations and share of the catch. Inevitably this will have to be at the expense of the Japanese longline fleet. Again the principal aims are maximisation of the harvest and of overseas earnings whilst avoiding over exploitation.

Data acquisition

Until recently only lip service had been paid to the creation of a sound statistical data base for fisheries. Prior to 1974 fishermen were only required to render monthly returns of days fished and quantities of species landed. An attempt to upgrade the system met with strong opposition and as a result few reliable data have been obtained since then. The recent creation of a Fisheries Statistics Unit attached to the Fisheries Research Division of the Ministry of Agriculture and Fisheries now makes it practical to develop a data base for both management and research. The Division has always been responsible for data from the offshore trawl fisheries and the tuna and oyster fisheries. With the advent of the controlled fisheries for rock lobsters these data too have been entered, as fishermen are required, as a condition of the licence, to render returns. The same now applies to the renewal of permits under the present moratorium on coastal fisheries. Thus, in the future, trends in stocks and in c.p.u.e. should be more readily perceived, but data for the critical period when New Zealand's coastal fisheries underwent such rapid change will never be available.

EVALUATION OF REGULATORY ALTERNATIVES

Species quota and area restrictions have been favoured as the simplest to administer. In the deep-water trawl fisheries these have been further refined by allocating quotas by species to nine companies, local and joint venture, according to a set of criteria based on known performance, available vessels, and onshore processing capabilities (Anon., 1982). Quotas of particular species can be traded between companies so that they can fish for the best mix of species to meet their processing requirements.

Regulatory measures for the tuna, squid, and rock lobster fisheries have already been mentioned, but others have been introduced for other species. For example, in the Foveaux Strait oyster fishery the fleet which was already limited to 23 oyster dredgers now has an overall seasonal quota plus a daily boat quota. In this fishery the objective is conservation of the local fishery; exports are prohibited. In the abalone fishery, which is widely scattered, there is a minimum size limit and scuba gear may not be used. The overall harvest is set by an export quota which cannot be exceeded. This is probably satisfactory in that local demand is reasonably stable. The adverse effect of this type of control is that stocks can be heavily depleted in local areas, but if, as seems possible, the stocks can be supplemented by aquaculture, there will need to be some modification to the fish farming regulations.

For scallop fisheries, seasonal and area closures plus quotas have been imposed primarily to stabilise the fisheries. Seasonal and area closures have also been introduced for some of the finfish fisheries and have been supplemented by mesh regulations and area/method limitations.

Inevitably, there are conflicts of interest between the various commercial fishermen using different methods to secure the same species and between them and recreational fishermen who are quick to blame the commercial operator for any decline in their sport.

To overcome some of these problems, the country has been divided into six major regions and within these Regional Fisheries Management Plans (RFMPs) are being developed first at the local level through port liaison committees. These committees, usually but not always chaired by a Ministry Officer, include management, research, and enforcement representatives from the Ministry and also commercial fishermen, processors, and local authority and recreational interests. The principal objective has been to provide a forum in which each group can participate and gain an understanding of the others' point of view.

Initially this procedure seems to be working well in that there is a surprising commonality of views between the various groups at the local level. Whether this can be carried through to the regional level, particularly where widely ranging fishermen fish within the sphere of interest of several local liaison groups, remains to be seen. One immediate problem will be that any future management measures will require sound data for decision-making and, as already noted, historical and research data are lacking for many of the coastal fisheries.

Furthermore, there remains the perennial problem of the large versus small vessel. As the recreational fisherman blames the commercial operator for decline in abundance of sports fish so the inshore fisherman blames the offshore operator for any decline in his catches. As yet there is no management policy which defines inshore/offshore limits for the medium sized craft, but in terms of the recently released deep-water plan (Anon., 1982) vessels over 45 m are excluded from fishing the 12-mile territorial sea, all of area B, and other areas now closed to foreign trawling.

ADMINISTRATIVE CONSIDERATIONS FOR REGULATION

New Zealand has a very long coastline for its size and population; therefore coverage by any enforcement agency is necessarily limited. On the other hand, with such a high proportion of the product going for export through a limited number of outlets there can be some overall surveillance of the production from the various species if not from the fisheries themselves. However, in an attempt to protect species, protect nursery areas, apply mesh and minimum size limits, define and police areas in which particular methods may be applied, conserve fish, and protect commercial and recreational interests, a plethora of regulations has evolved which the enforcement agency has been unable to police. The new Fisheries Act and the development of RFMPs will, it is hoped, lead to rationalization of regulations on the one hand and a greater willingness to cooperate on the other. Furthermore, with the current moratorium on the issue of further fishing permits and the requirement that renewals will be dependent upon provision of adequate statistics for the preceding year, it is expected that fishermen will appreciate the need to cooperate.

Even so, in the traditional coastal fisheries, it is now apparent that there is too much effort being applied to the resources and measures to reduce effort either by a buy-back scheme or redeployment to less traditional fisheries seem to be inevitable.

In the offshore fisheries the principal administrative considerations have been simplicity and effectiveness. All licensed vessels are required to make a port call before they commence fishing so that their gear can be inspected and they can be instructed with respect to the regulations. Similarly they must make a port call when they cease fishing and before they leave the zone. Trawlers fishing the deep water are required to report their noon day position and their daily catch to the Fisheries Control Centre so that positions and accumulated catches can be monitored. In return, the Control Centre issues a warning before a quota is reached so that vessels can prepare to leave an area. With the jig vessels and liners there are similar requirements, except that weekly positions are usually sufficient unless a vessel or group of vessels moves a significant distance.

This procedure reduces the need for air and sea surveillance of the fleet but is only practical because of the exclusive nature of the zone. It has also had the effect of reducing the number of enforcement officers aboard foreign vessels to an absolute minimum. Although this may be less expensive and more convenient, it does mean that on the larger vessels there are far too few direct observations of catches and of operations which can be checked against the daily logs each vessel is required to complete. The only occasion when the presence of enforcement officers is obligatory is when catcher vessels are offloading to a reefer. In this case the transhipment must take place in a designated area in the presence of two or more officers. In such cases the off-loaded catch can be assessed in relation to the reported catch in much the same way as the stored catch is checked when a vessel makes its port call before leaving the zone.

CONCLUSIONS

Within the limitations on available staff and in economic terms the surveillance of the licensed and joint venture vessels fishing the EEZ may be regarded as satisfactory, although the paucity of observers aboard the vessels inevitably raises doubts where apparent discrepancies arise between reported catches and log book records. Similarly, reports of infringements can seldom be checked. Quota constraints as currently proposed can be operated reasonably effectively, but these in turn are primarily dependent upon good research data which defines the standing stocks and the proportions which may be harvested. At present there are inadequate facilities or personnel for regular stock assessment surveys and inevitably there is some concern that the quotas may not remain within the necessary bounds to permit sustained yields. To some extent this concern could be removed once a sufficiently long time series of c.p.u.e. data has been established. One disadvantage of the recently released deep-water plan is that it only sets quotas for seven major species, whereas others such as barracouta and jack mackerel - important to some companies - may well be subject to additional fishing pressure.

In the meantime the degree to which New Zealand fishermen participate in the exploitation of the resources will depend upon how and if joint venture and licensed vessels are phased out of the fishery and how acceptable this may be at the political level.

In the coastal fisheries the paucity of recent c.p.u.e. data makes management decision making in terms of who should or should not have access to the resources much more difficult. As mentioned earlier, there is the classic problem of too many fishermen chasing too few fish. Management regimes aimed at conserving the resources and at the same time preserving the livelihood of coastal fishermen need to be developed as soon as possible. Continuation of employment could come in part from redeployment either to fisheries for less traditional coastal resources or to deep-water craft. This in turn requires an integrated approach to the management of the total EEZ because although the coastal species may be over exploited, the total resources have yet to be fully developed.

REFERENCES

Annala, J.H., The introduction of a limited entry fishery for New Zealand rock lobsters. Mar.Policy, (in press)

Blezard, R.H., 1980 Calculated sea area of the New Zealand 200 nautical mile Exclusive Economic Zone. N.Z.J.Mar.Freshwat.Res., 14:137-8

Fisheries Research Division, 1976 Proceedings of the skipjack tuna conference, July 1976. Occas.Publ. Fish.Res.Div.Minist.Agric.Fish.N.Z., (11):62 p.

Francis, R.C. and K.A. Fisher, 1979 Assessment of the deep-water fish resource of the New Zealand area. Occas.Publ.Fish.Res.Div.Minist.Agric.Fish.N.Z., (21):51 p.

Habib, G., I.T. Clement and K.A. Fisher, 1980 The 1977-78 purse-seine skipjack fishery in New Zealand waters. Occas.Publ.Fish.Res.Div.Minist.Agric.Fish.N.Z., (25):42 p.

_____, 1980a The 1978-79 purse-seine skipjack fishery in New Zealand waters. Occas.Publ. Fish.Res.Div.Minist.Agric.Fish.N.Z., (26):39 p.

_____, 1980b The 1979-80 purse-seine skipjack fishery in New Zealand waters. Occas.Publ. Fish.Res.Div.Minist.Agric.Fish.N.Z., (29):43 p.

_____, 1981 The 1980-81 purse-seine skipjack fishery in New Zealand waters. Occas.Publ. Fish.Res.Div.Minist.Agric.Fish.N.Z.,(36):52 p.

James, G.D., Big changes in Bay of Plenty trawl catches. Catch '80, 7(6):3-4
1980

Murphy, G.I. and J. Majkowski, State of the southern bluefin tuna populations: fully exploited.
1981 Austr.Fish., 40(11):20-9

Patchell, G.J., The Westland hake fishery. Occas.Publ.Fish.Res.Div.Minist.Agric.Fish.N.Z., (31):18 p.
1981

_____, The New Zealand hoki (Macruronus novaeselandiae) fisheries, 1972-81. Occas.
(in press) Publ.Fish.Res.Div.Minist.Agric.Fish.N.Z., (38)

Roberts, P.E., Albacore off the north-west coast of New Zealand, February 1972. N.Z.J.
1974 Mar.Freshwat.Res., 8:455-72

_____, 1971-72 tuna survey, west coast, South Island. Occas.Publ.Fish. Res.Div.Minist.
1975 Agric.Fish.N.Z., (8):16

_____, 1973 tuna survey, west coast, South Island. Occas.Publ.Fish. Res.Div.Minist.
1977 Agric.Fish.N.Z., (12):12

Roberts, P.E., D. Baker and E.B. Slack, Tuna in New Zealand waters. Occas.Publ.Fish. Res.Div.
1972 Minist.Agric.Fish.N.Z., (4):31

Robertson, D.A., Orange roughy resource survey. Catch '82, 9(7):21
1982

Saila, S.B. et.al, Application of yield models to the New Zealand rock lobster fishery. N.Z.J.Mar.
1979 Freshwat.Res., 13:1-11

Smith, P.J., P.E. Roberts and R.J. Hurst, Evidence for two species of arrow squid in the New Zealand
1981 fishery. N.Z.J.Mar.Freshwat.Res., 15:247-53

Van den Broek, W.L.F., Recent research on the Challenger Plateau. Catch '81, 8(11):6-7
1981

Waugh, G. Duncan, Resource potential of the 200-mile Economic Zone. Fish.Ind.Board Bull., (42):8
1977

_____, Trevally resources and management problems: Bay of Plenty. Catch '77, 44(11):3-4
1977a

Anon., Priority for domestic fleet. Catch '81, 8(5):12
1981

_____, Deepwater trawl plan agreed. Catch '82, 9(11):28
1982

MANAGEMENT OF THE SHRIMP FISHERY OF THE GULF OF MEXICO

by

Fisheries Management Division
Southeast Regional Office
National Marine Fisheries Service
9450 Koger Boulevard
St. Petersburg, Florida, USA

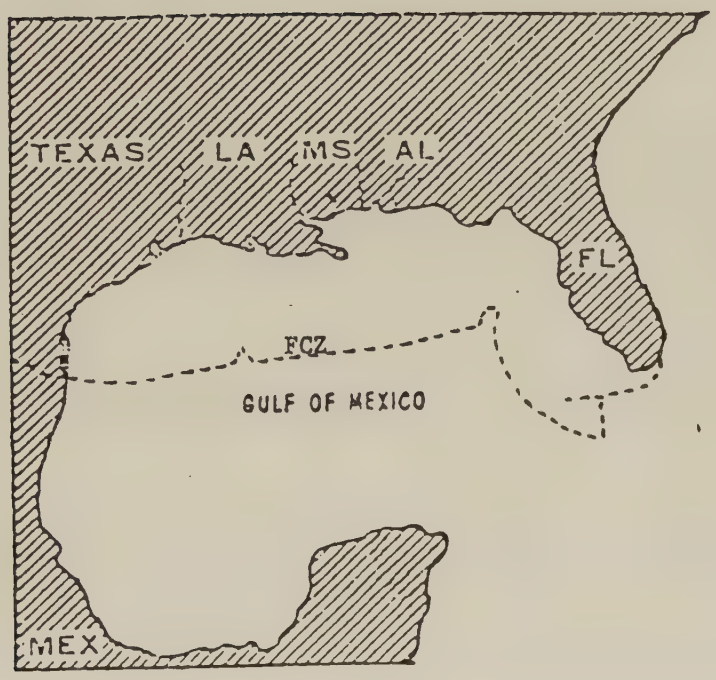


Figure 1

INTRODUCTION

The Magnuson Fishery Conservation and Management Act provides for exclusive United States management authority over the fishery resources of the Gulf of Mexico (Figure 1), within a fishery conservation zone (FCZ) extending from the seaward boundary of the United States territorial sea (3 nautical miles for the Gulf of Mexico States of Louisiana, Mississippi and Alabama, and 9 nautical miles for Texas and the west coast of Florida) to a point 200 miles from shore. Responsibility for developing a shrimp fishery management plan for the Gulf of Mexico is vested in the Gulf of Mexico Fishery Management Council (GMFMC); and implementation and enforcement of any regulations pertinent to the management of fisheries within the FCZ are the responsibility of the Secretary of Commerce and the US Coast Guard.

One of the management strategies proposed in the plan was to reduce growth over-fishing 1/through closing selected areas to fishing. These closed areas were designed to increase the total weight and value realized from the shrimp fishery. This paper presents a discussion of the results obtained from two years of managing the shrimp resource.

THE GULF OF MEXICO

The Gulf of Mexico is a large embayment of the Atlantic Ocean that is almost surrounded by the United States and Mexico. The Gulf forms a huge ocean basin that covers nearly 700,000 square miles (1,800,000 square kilometres). It is 800 miles (1,300 kilometres) long on the north-south axis and 1,100 miles (1,770 kilometres) wide on the east-west axis. The Yucatan Channel connects the Gulf of Mexico with the Caribbean Sea and the Straits of Florida join it to the Atlantic Ocean.

The low level coastline of the Gulf of Mexico is about 3,000 miles (4,800 kilometres) long. It has hundreds of lagoons and many salty marshes bordered by sand bars. The water of the Gulf is deepest (12,700 ft or 3,871 m) near the coast of Mexico, while depths in other areas range upwards to about 10,000 ft (3,080 m). The Yucatan Channel and the Straits of Florida are not nearly so deep. The Gulf has many shallow areas with gently sloping beds formed by siltation.

THE FISHERY

Annual harvests of shrimp consistently lead the nation's fisheries in terms of ex-vessel value. In 1981, total US commercial landings for all fisheries were 5.98 billion pounds (heads on) valued at $463.4 million. The Gulf of Mexico shrimp fishery accounted for about 75.6 percent of the total shrimp landings. Shrimp landings in the Gulf amounted to about 16.8 percent of the total ex-vessel value for all US fisheries and 86.6 percent of total shrimp value.

The fishery is probably the most diverse in the nation. Harvesters include: (i) a large commercial fleet fishing the inshore, coastal and open Gulf waters, (ii) an undetermined (but large) number of recreational shrimpers, mainly fishing the inshore and nearshore Gulf waters, and (iii) a substantial number of bait shrimpers, mainly fishing the inshore waters. In all, about 9,000 boats and vessels participate in the fishery in the Gulf.

The fishery is based on six species occurring in the area of concern to the GMFMC, as well as in the adjacent territorial seas and associated bays, inlets and wetland areas. Species included are brown shrimp (Penaeus aztecus Ives), white shrimp (Penaeus setiferus Linnaeus), pink shrimp (Penaeus duorarum Burkenroad), royal red shrimp (Hymenopenaeus robustus Smith), seabobs (Xiphopeneus kroyeri Heller), and rock shrimp (Sicyonia brevirostris Stimpton). The latter three species are, for the most part, taken as incidental by-catch. The management plan addresses the fishery throughout its range; however, Federal regulations are implemented only in the FCZ.

None of the stocks appear to be biologically over-fished. Major concerns for the future are related to the preservation of adequate habitat, particularly for the estuarine-dependent brown, white and pink shrimps, which account for approximately 98 percent of the total annual shrimp harvest.

The biological characteristics which affect sustainable yields for penaeid shrimp are unique. They are an annual crop; very few individuals live a year and the majority harvested are less than six months old. There is no demonstrable stock-recruitment relation and recruitment over-fishing, given present fishing technology, may be unlikely. That is, it may not be economically or technically feasible to take so many shrimp that the supply for the following years is affected. Because of these characteristics, fishing mortality in one year does not determine yield in the following year. The maximum sustainable yield (MSY) in number for a given year is considered to be all the shrimp available to harvest, using current fishing technology.

1/ Growth over-fishing is that level of fishing which results in a reduction in the capacity of the stock to produce the maximum biological yield due to harvesting fish at a size below their optimal size.

Growth over-fishing is caused by taking the available recruits at too small a size. If growth over-fishing is occurring, allowing additional time for growth will permit taking a greater total yield in weight, although the total number of individuals will be less. Effort in the fishery has been increasing rapidly and it is probable that the total yield of penaeid shrimp could be increased if the average size taken were larger.

The abundance (number of recruits) and therefore yield and catch per unit effort vary greatly from year to year, depending on environmental conditions (especially temperature and salinity) in the estuarine nursery areas. This is evident when regression coefficients for different models are compared. For example, linear regressions of catch on effort showed that effort alone explained only 38 percent of the variation in catch of white shrimp off Louisiana and 57 percent of the variation in brown shrimp catch in the Gulf. Multiple regressions including environmental parameters explained 89 percent and 88 percent of the variation in catch, respectively. For brown shrimp, the environmental model predicts that, at a fishing effort of 100,000 units (essentially the record until 1976), annual catch would vary from 57 to 88 million pounds, provided temperature and salinity ranged within levels reported for the period 1963-1975. If environmental conditions were more favourable, a greater yield would be expected.

MANAGEMENT

The goal of the plan is to manage the shrimp fishery of the Gulf of Mexico to attain the greatest overall benefit to the nation, with particular reference to food production and recreational opportunities. Problems, objectives and management measures to achieve the goal of the fishery follow:

Problems :

1. Conflict among user groups as to area and size at which shrimp are to be harvested.
2. Discard of shrimp through the wasteful practice of culling.
3. The continuing decline in the quality and quantity of estuarine and associated inland habitats.
4. Lack of comprehensive, coordinated and easily ascertainable management authority over shrimp resources throughout their range.
5. Conflicts with other fisheries such as the stone crab fishery in southern Florida, the groundfish fishery of the north-central Gulf, and the reef fish fishery.
6. Incidental capture of sea turtles.
7. Loss of gear and trawling grounds due to man-made underwater obstructions.
8. Lack of basic data needed for management.

Objectives :

1. Optimize the yield from shrimp recruited to the fishery.
2. Encourage protection measures to prevent undue loss of shrimp habitat.
3. Coordinate the development of shrimp management measures by the GMFMC with shrimp management programmes of the several states, where feasible.
4. Promote consistency with the Endangered Species Act and the Marine Mammals Protection Act.
5. Minimize the incidental capture of finfish by shrimpers, when appropriate.
6. Minimize conflicts between shrimp and stone crab fishermen.
7. Minimize adverse effects of underwater obstructions to shrimp trawling.
8. Provide for a statistical reporting system.

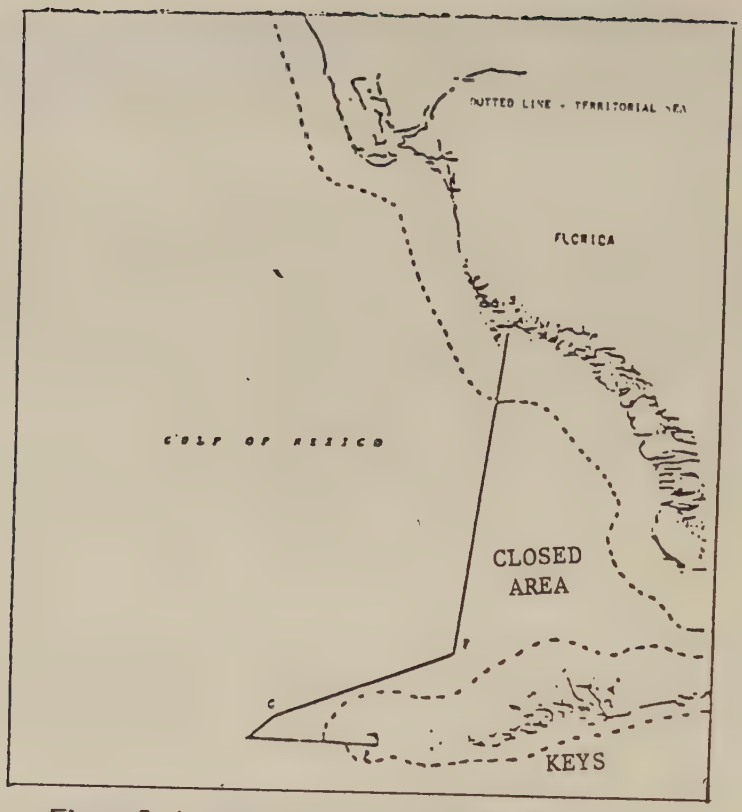


Figure 2 Location of Tortugas Shrimp Sanctuary

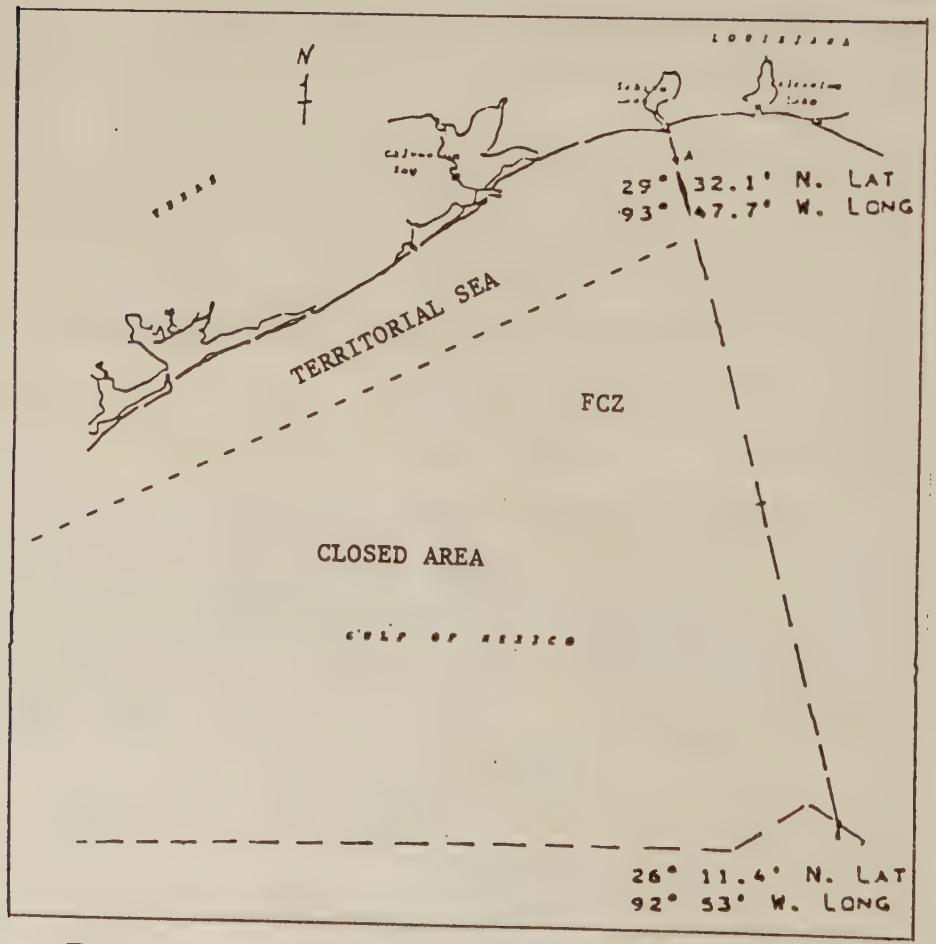


Figure 3 Seasonal closure to shrimping off the State of Texas

In order to obtain the above objectives, the following management measures and recommendations were adopted:

Management measures :

1. Establish a cooperative permanent closure with the State of Florida and the US Department of Commerce of an area off Florida (Figure 2), to protect small pink shrimp until they leave the closed area where they generally have reached a size range larger than 69 tails to the pound.
2. Establish a cooperative closure of the territorial sea of Texas and the adjacent US FCZ (Figure 3), with the State of Texas and the US Department of Commerce, during the time when a substantial portion of the brown shrimp in these waters weigh less than a count of 65 tails to the pound (39 heads-on shrimp to the pound).
3. Consistent with the Stone Crab Management Plan, establish a seasonal closure of a portion of the Dry Tortugas shrimp grounds, in order to avoid gear conflicts with stone crab fishermen.
4. All statistical reporting requirements will be mandatory.

Management recommendations :

1. Recommend that all Gulf states consider establishing shrimp management sanctuaries in important segments of nursery grounds under their sole jurisdiction. The GMFMC has established an internal committee to review and assess the status of Gulf fishery habitats, with particular attention to those factors which might further stimulate "the downward trends in quality and quantity of fish habitats".
2. The Gulf states are encouraged to adopt flexible management procedures which would provide regulation by administrative agencies of the shrimp resources in inland waters and territorial seas.
3. The Gulf states are encouraged to adopt reciprocal internal management decisions flexible enough to allow joint management of shrimp with other states and with the Department of Commerce.
4. Develop and implement educational programmes to inform shrimpers of the current status of sea turtle populations and of proper methods for resuscitation and return to the sea of incidentally captured sea turtles.
5. Encourage research on development of shrimping gear in order to reduce the incidental catch of finfish without decreasing the overall efficiency of shrimping or excessively increasing the cost of gear.
6. The GMFMC will attempt to reduce, where feasible, the loss of offshore trawlable bottom by establishing within their Council a committee to monitor and review construction of offshore reefs, with attention to the needs of the reef fish and shrimp user groups.

OPERATION

The ten management measures and recommendations which describe the management strategy were transposed into an operation plan to facilitate implementation and monitoring. Twenty-four actions were identified as being necessary in order to accomplish the stated goals. They involved actions in the broad areas of regulation, state cooperation, research, development, enforcement, data systems and habitat, and environment conservation. A time schedule for the actions was established, with some of the long-range research programmes requiring up to five years to accomplish.

DISCUSSION OF AREA CLOSURES

A major management objective is directed at reducing growth over-fishing. The strategy employed involved establishing a shrimp sanctuary off south Florida and a seasonal closure off Texas. The theory behind these closures was simply that, if the shrimp were protected from fishing mortality for some period of their lives, they would grow to a larger and more desirable size. The harvesting of these larger shrimp produces a greater weight, a higher catch per unit effort, and the value of the shrimp increases.

In determining the type of closures to invoke, several factors were considered. The fishery off Texas is a brown shrimp fishery, with recruitment and migration offshore occurring in a short predictable period of time, thus a 45 to 60 day seasonal closure was selected. In the area of the Northern Gulf, there is a strong market for small shrimp and a desire by fishermen to harvest those small shrimp; no closure was designed for that area. Recruitment of pink shrimp off Florida seems to fluctuate throughout the year and cannot be predicted, so the establishment of a permanent sanctuary was selected to provide the most benefit.

The establishment of the Tortugas shrimp sanctuary, a permanent closed area off south Florida, is presumed to have provided positive benefits, although several years of data will be necessary to fully evaluate the closure. Size and frequency distribution data collected within and around the closed area for a period of about one year generally demonstrate the utility of the closed area, because shrimp within the area are mostly too small (less than 103 mm) to optimize production.

However, analysis of the closure has surfaced a question concerning migration patterns which could have significant impact on evaluating the benefits of the closure. The scientific data which are available, although weak, indicate that shrimp migrate from the sanctuary into fishable areas. However, fishermen believe that shrimp migrating from a portion of the sanctuary mostly enter areas which are non-fishable because of coral and other obstructions and are thereby lost to the fishery. If these shrimp migrate into this non-fishable area, the benefits from the closure would be reduced.

To determine the migratory pattern of shrimp from this area of the sanctuary, a concentrated mark and recapture study was begun in November 1982. This study will last from one to two years and provide a major part of the information necessary for a thorough evaluation of the closure.

The seasonal closure of the FCZ off Texas has been in effect for two seasons and its impacts have been measured. This closure is designed to be concurrent with the closure of the Territorial Sea (water controlled by the State of Texas, from the beach out to nine nautical miles). The closure is usually in effect from 1 June until 15 July of each year; however, there is up to 15 days' flexibility on either end of the period. Thus, the actual period of the closure will range from 45 to 60 days. A sampling programme to determine the size of the shrimp within the internal waters of Texas is the basis for setting the period of closure for both the FCZ and the State Territorial Sea.

Texas has seasonally closed its Territorial Sea since 1959 but the seasonal closure of the FCZ has been in effect only in 1981 and 1982. In evaluating the impact of the closure, only the area in the FCZ was considered; although the closure of the Territorial Sea provides additional benefits, perhaps even greater than the closure of the Federal Zone.

In order to evaluate the effects of the closure, research vessels sampled shrimp populations in the closed area from May to July in 1981, to estimate the magnitude and size composition, as well as temporal changes, of the shrimp population in the closed area. In addition, data on fishery activities (catch, effort and location of fishing) were collected for the entire Gulf by interviewing dealers and selected fishermen. At-sea observers on shrimp vessels, in the course of other duties, collected data on magnitude and species composition of the incidental catch of fish in both closed and open areas. Finally, data were collected to measure the impact of the closure on shore facilities and processors. Both the impact on facilities outside the areas, from boats migrating elsewhere during the closed period, and also local impact upon opening the area were measured. The research was designed to answer a set of management questions formulated in consultation between fishery scientists and fishery administrators.

The topics covered and answers provided for the 1981 study follow:

1. Abundance of shrimp in the area during the time it was closed:

   The closure was effective in protecting juvenile shrimp in the closed area. Recruitment to the FCZ closed area in 1981 was strong and shrimp in the area during the closed period are estimated to have increased in weight approximately 78 percent. Although recruitment to the area was strong, it does not satisfactorily account for the highly successful July-August fishery off Texas. In particular, observed catches and catch rates offshore of Texas were higher than would have been predicted from existing recruitment indices based on historical data.

2. Quantity and value of brown shrimp harvested by the regulated fishery compared with amounts that would have been taken had the fishery not been regulated:

   Because of excellent Gulf-wide recruitment and protection of shrimp off Texas, catches in 1981 were at record levels. The June through August catch was 25 million pounds off Texas and 18 million pounds off Louisiana. In 1977, the best year of the 1976-80 period, catches were 19 million pounds off Texas and 18 million pounds off Louisiana. The closure is estimated to have increased the harvest in the Gulf offshore brown shrimp fishery from a probable 61 million with no closure to an actual catch of 65 million pounds with closure, a 4 million pound (7 percent) gain. The effect of the closure was valued at an increase of 9.4 million ex-vessel dollars.

3. Changes in fishing patterns and use of shore facilities that resulted from the closure:

   The pattern of fishing effort in 1981 was significantly different from that observed in 1980. However, declines in catch rates resulting from this different distribution of fishing activity and from possible concentration of effort were not obvious.

   The disruption of historic seasonal fishing patterns, resulting from the closure, had two effects on shore facilities - one anticipated and one unanticipated. The anticipated effect was that, because of the closure, some vessels which had historically fished in the area migrated into other areas in 1981. Although this migration was extensive and some of these vessels landed their catch in different ports, the shift in landings was not large enough to have any detrimental effect on shore facilities.

   An unanticipated effect was the large amount of landings at Texas ports, after the area was opened, which resulted in difficulties in processing the catch. Vessels were delayed in unloading and, on several occasions, landings had to be trucked to other localities for processing. These difficulties occurred mainly near the opening of the fishing season and were exaggerated by bad weather that caused many of the vessels to land catches at the same time. After these initial problems, additional personnel were hired to process the larger catches and no major difficulties occurred.

4. Other possible effects on the resource and fishery (by-catch):

   Cessation of trawling for 55 days followed by very intensive fishing conceivably could have affected the numbers of shrimp predators as well as the number of shrimp; however, no changes in the amount of fish taken incidentally were apparent.

   Discarding of shrimp was not a major difficulty, although some were discarded from the catches when fishing resumed. This practice reportedly occurred because the crews could not process the large catches that were brought aboard the vessels, and the problem was quickly resolved by hiring additional persons to work on the vessels.

Conclusions from the 1981 study were that the Texas closure provided a benefit by increasing the overall yield and value of the brown shrimp fishery in the Gulf. The benefits were large because of the high level of recruitment experienced in 1981. It appears from the estimates that the overall economic gains substantially outweighed any losses resulting from price, a decline due to increased supply. Although not quantified, benefits undoubtedly resulted from increased employment in both the processing and harvesting sectors of the fishery. The change in fishing patterns clearly affected the density of shrimp populations; however, effects on organisms associated with shrimp, which probably occurred, were not obvious.

A study of the results of the second year of the closure (1982) presented a somewhat different picture. Again, for the 1982 season, a set of management questions were presented and a research and data collection system was designed to answer these questions. Following are the questions and their answers as defined by an analysis of the preliminary data.

1. What was the abundance of brown shrimp in the Northern Gulf of Mexico during the 1982 closure period compared to 1981?

   Two factors made the impacts of the Texas closure much different in 1982 from those in 1981. The first was that recruitment was estimated to be 22 percent lower in 1982 than in 1981. The second factor was that shrimp did not migrate as far offshore in 1982 as they did in 1981. In 1982 recruits were distributed inside 20 fathoms off Texas, whereas in 1981 recruits extended out to 35 fathoms. Fewer shrimp were available for harvest in 1982, especially in the FCZ. Cruise surveys show that this low abundance was generally Gulf wide.

2. What was the catch upon opening the closed area?

   Because of below average recruitment, catches in 1982 were much lower than in 1981. Offshore catches from the closed area during the period 15 July through August were down 45 percent from 1981.

3. What were the biological impacts of the 1982 closure?

   Simulation models, yield per recruit models and catch data were analysed for 1982 to determine the impacts of the closure. The results of these studies were consistent and indicated that biological impacts were of a magnitude below detectable levels, given the precision of the modelling technique. Thus, the closure of the FCZ, with no consideration of the closure of the State's waters for 1982, provided no detectable benefit or loss. However, it appears that, if the closure of both the Federal and State waters were considered, positive benefits could have been detected. A study of the combined effects of the closure of both the Federal and State waters will be done in 1983.

4. What were the estimated economic benefits of the 1982 Texas Closure?

   No detectable change in landings can be attributed to the closure; thus, no change in price or value is assumed.

5. Were there operational problems at Texas ports resulting from the closures in 1981 or 1982?

   There was little or no discarding of shrimp reported in 1982. No market problems were reported in 1982. In 1981, as a result of very heavy production upon opening the area, some short-term gluts were reported by processors in Texas. There was no detectable shift in fishing patterns between States in 1982 from that experienced in 1981.

CONCLUSION

The shrimp fishery has been under management for about two and a half years. A complete evaluation of the management regime will require several more years. However, a major component of the management strategy is the seasonal closure off Texas, and some basic conclusions are evident from studies of the two closures to date. It appears that, because shrimp are an annual crop and their abundance is determined primarily by environmental conditions, the impact of a seasonal closure can range from very beneficial to non-detectable. During years of good recruitment, such as 1981, the seasonal closure provided excellent gains both in terms of number of pounds landed and value of the harvest. In years of low recruitment, such as 1982, benefits derived from the closure seem to be reduced. With several years of data, it may be possible to model the closure and predict those years in which benefits are expected. If this is possible, a more efficient closure can be established.

The seasonal closure, as well as all aspects of the shrimp management regime, will be continued for 1983, with its effects being monitored and refinements of management strategies made. In the short period of time that management has been in effect, major benefits have been observed with only minor losses being incurred.

Studies are currently being pursued to further evaluate the effects of closing the Tortugas Sanctuary off South Florida. Shrimp migratory patterns in this area are poorly defined, and could have considerable impact on the benefits derived from this permanent closure. Mark-recapture studies should provide insight into whatever modifications might be needed to improve the management strategy in this area.

REGULATION OF FISHING EFFORT IN CUBAN SHELF FISHERIES: The case studies of shrimp, lane snapper and spiny lobster fisheries

by

Julio A. Baisre, Armando Pérez, Maria H. Obregon y Raul Cruz
Centro de Investigaciones Pequeras
La Habana
Cuba

1. INTRODUCTION

Progressive growth of fish landings in Cuban domestic fisheries during the last decade having approached and in some cases surpassed the potential yields for most demersal species, it has become necessary to develop several measures to control fishing effort. Regulation of fishing effort has been accomplished by using different methods according to the nature of the species being managed.

The case studies of three commercial species very important for the Cuban fisheries industry,with different life cycles and different habitats and fished with different gears, are presented in this paper.

Penaeid shrimps (Penaeus spp.) are currently exploited by industrial fisheries, without artisanal fisheries exploiting the juvenile stages living in estuarine areas. Shrimps also have a short life span and, as pointed out by Garcia and Le Reste (1981), the time unit which is used to describe the events must therefore be less than a year.

Lane snapper (Lutjanus synagris) is the most important individual fish species in Cuban shelf fisheries. Pre-spawning mass grouping of these fish takes place before the massive reproductive migration, which occurs from first quarter moon to full moon and from April to June with highest intensity in May. Fishermen already know the main migratory routes and set fixed nets which in a few weeks account for more than 50 percent of the annual catch.

Spiny lobster fisheries are carried out in the extensive shallow areas of the Cuban shelf where seagrass beds and coralline growth are abundant. Spiny lobster have a long life span and are caught with artisanal fishing gears.

Larval development takes place in oceanic waters far off shore and, because of a long larval life, possibilities that phyllosome produced in the south Caribbean sea could be recruited to the Cuban population can not be ruled out.

2. THE SHRIMP FISHERIES

Although this fishery has been carried on in Cuba for nearly fifty years, it was only in 1979 that concern arose that a state of over-exploitation had been reached, as shown by declining catches, and a research programme was launched to discover means to stop diminishing yields and restore the resource. What follows will mainly refer to the evolution of shrimp fisheries, management with respect to fishing effort regulation, as a general description of research carried out, assessments made and the management system has been recently presented by Baisre (1982). Special mention will be made of two cases, the Ensenada de la Broa fishery and the Manzanillo fishery.

2.1 Description

Since 1973, the fisheries have been conducted by trawlers, whose fishing power has been made increasingly uniform by the growing participation of standard Cuban ferro-cement vessels (17.9 m overall length), although there are steel trawlers (22.9 and 25.2 m overall length) fishing in deeper and less protected areas. Species caught are white shrimp (Penaeus schmitti) and pink shrimp (Penaeus notialis) with the last one forming the bulk of catches. The main recruitment period is from September to December when young sub-adult shrimps migrate in mass into the fishing grounds (Baisre and Paez, 1981).

Since 1976, each of the five enterprises exploiting the resource has a defined fishing area with a general statistical system based on 25 $n.mi^2$ sub-areas for catch, effort and size composition reporting (Figure 1).

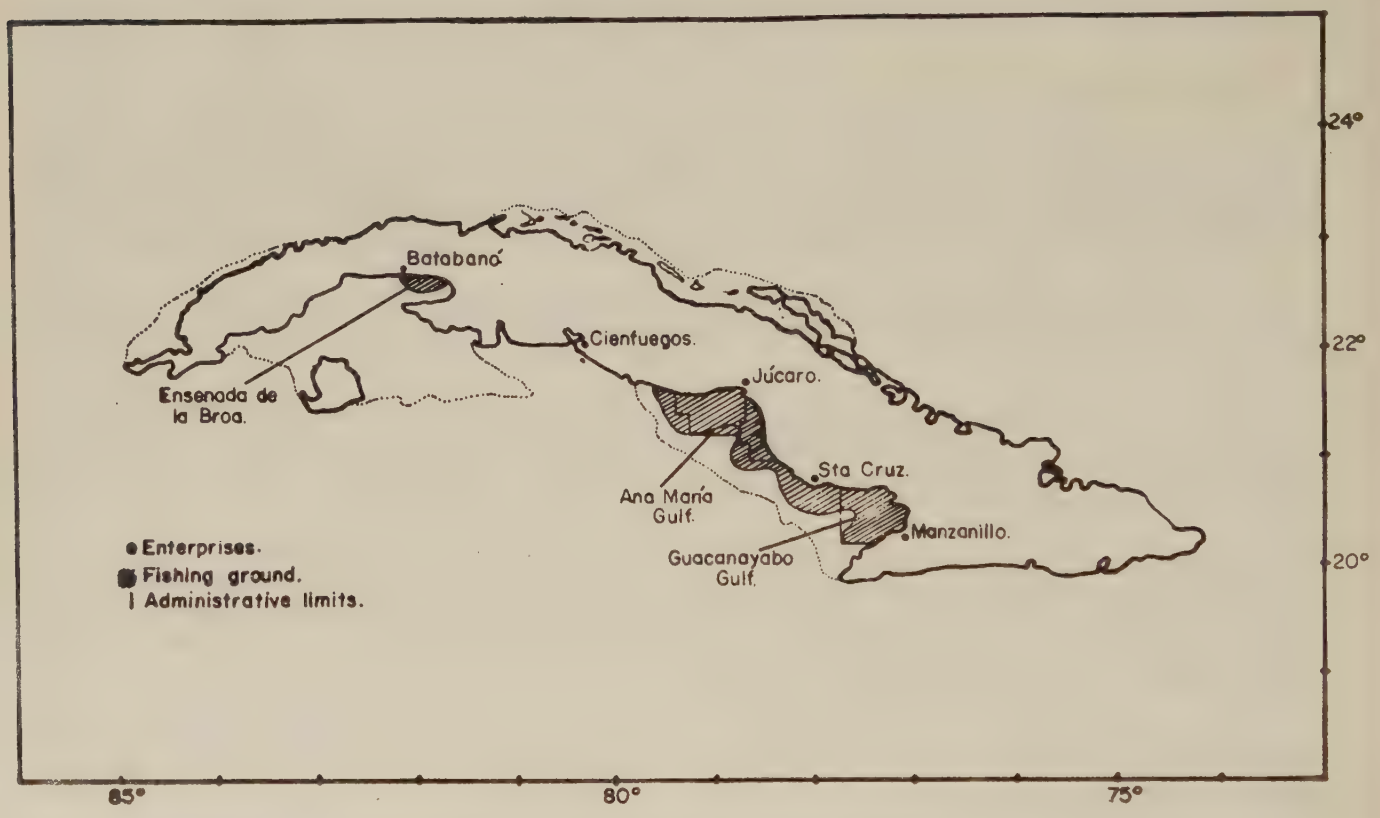


Figure 1 Distribution of commercial shrimp and fishing enterprises management areas

The fishing gear is the standard western jib trawl, used singly up to 1968-1971 when all vessels were changed to double rigged trawl. During 1972-1976, "twin" trawls were introduced, increasing again the fleet's fishing power. In 1979 it was felt the effort must be diminished (Pérez et al, 1980) and later assessments show (Pérez et al, 1981a) that it was about 1976 when the increase in efficiency of the gear and the number of vessels caused the exploitation level to exceed the one corresponding to MSY, so the need for effort regulatory-actions became evident.

In 1977 there was news from fishermen of the presence of fairly large quantities of shrimp in the Ensenada de la Broa area, 23 years after its spectacular discovery in 1953 and decline in 1954 (Pérez, 1954; Farfante, 1955). From the beginning it was defined as a unique experimental fishery area and monthly research cruises have been carried by the Centro de Investigaciones Pesqueras (CIP), statistics carefully recorded and monthly advise given on management by biologists in meetings with the fishermen and officers of the enterprise and the Ministry of Fisheries.

2.2 The Management System

Due to their short life cycle, high mortality and high economic value, shrimp population management needs to be flexible, operational and accurate (Pérez et al, 1981; Pérez, 1982), and for that reason a shrimp catch bureau was proposed by the CIP in 1980 (Pérez et al, 1980) to keep a continuous check on the fishery and population by a competent technical staff, in order to control fleet behaviour and obtain data to refine the assessments and fishery regulations. A concise statement of the general management system and management objectives for this fishery in Cuba is given in Pérez et al. (MS). Since its inception the Catch Bureau has taken into account the "profit index" 1/(Pérez, in press) for areal/seasonal fleet effort allocation, as it gives a clear and synthetic measure of economic effort effectiveness. Though it is obvious that individual fishermen spontaneously look for areas of higher "profit index", the limited area searched by each individually and the lack of cooperation among them make total fleet operation much less efficient.

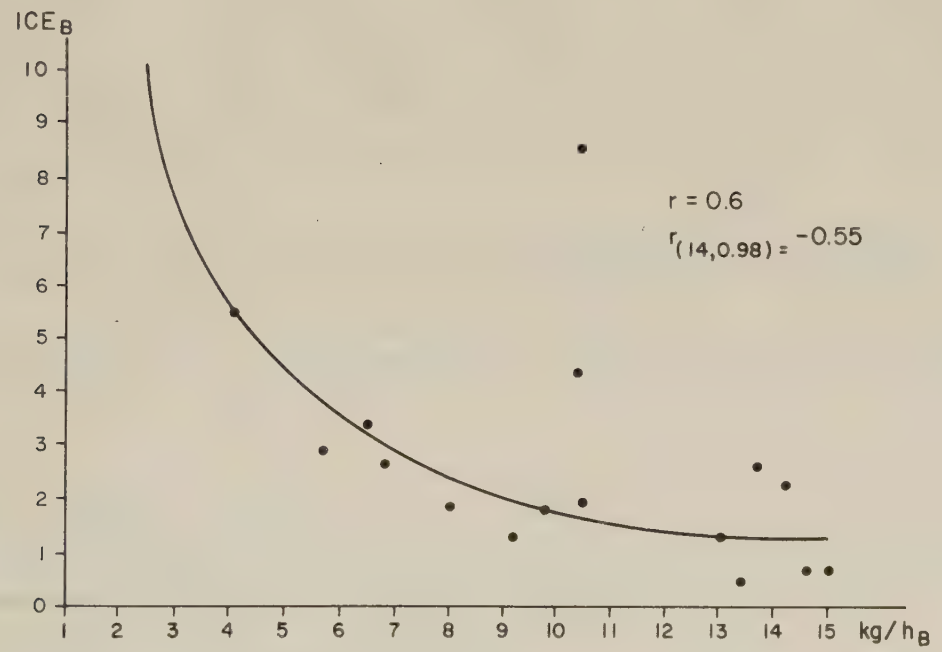


Figure 2 Relation between economic index of effort concentration (ICE) and c.p.u.e. for white shrimp (kg/h) in the Ensenada de la Broa fishery (from Pérez et al, 1981)

1/ "Profit index" is computed as the monetary value of shrimp obtained by unit of effort, taking into account size composition and c.p.u.e.

In Figure 2 is shown the relation between the monthly economic index of effort concentration, computed as the correlation between "profit index" and fleet effort by 9 n.mi^2 for the Ensenada de la Broa white shrimp fishery and population abundance, expressed as the mean c.p.u.e. in research cruises; it clearly shows the steadily decreasing trend in efficiency towards a completely random effort distribution (concentration index value 1.0) as abundance rises and total daily gain per vessel approaches the mean satisfaction level. The evolution of the monthly c.p.u.e. index of effort concentration for the Manzanillo fleet before and after the Catch Bureau's operation is shown in Figure 3 where a clearly increasing trend in efficiency is noted.

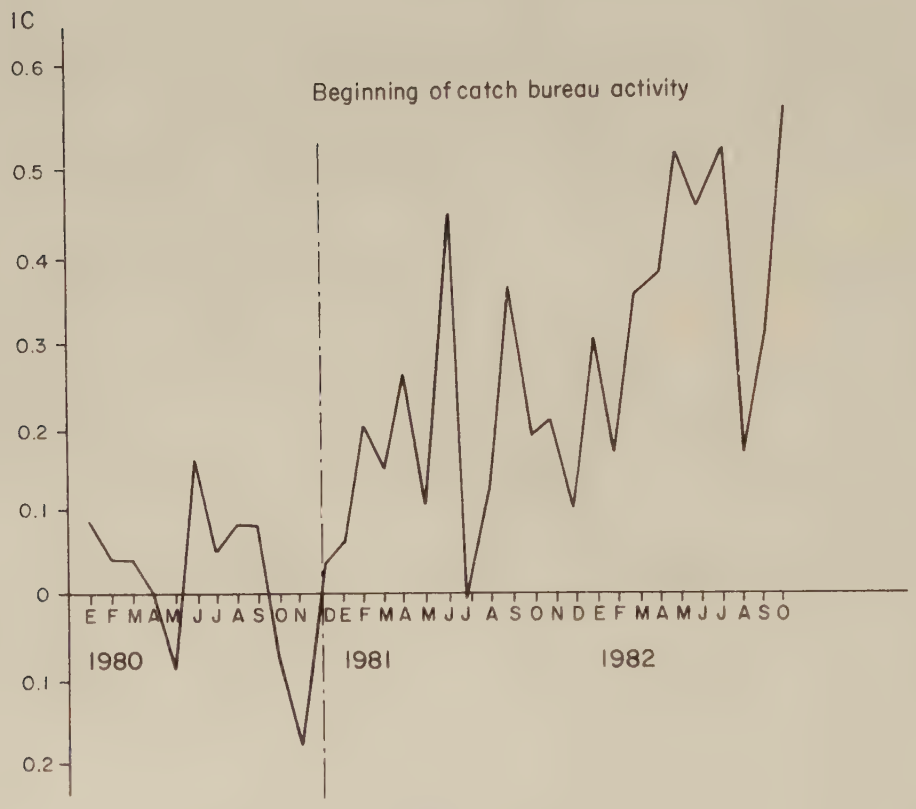


Figure 3 Monthly value for the "c.p.u.e. index of effort concentration" (IC) computed as the correlation between c.p.u.e. and effort per 25 n.m^2 squares

2.3 Control of Fishing Effort

The Ensenada de la Broa Fishery :

This small area (1,450 km^2), lying on the south-western part of Cuba, is isolated from the main south-eastern fishery by the deep waters of the Gulf of Cazones and supports an independent shrimp population distributed along its northern coast, comprising pink and white shrimp with the additional presence of the small rock shrimp (Sicyonia tipica) which is found only here in significant quantities. White shrimp is found no farther than six miles offshore, while pink and rock shrimp are distributed throughout the area, the younger pinks being nearer the shore (Figure 4).

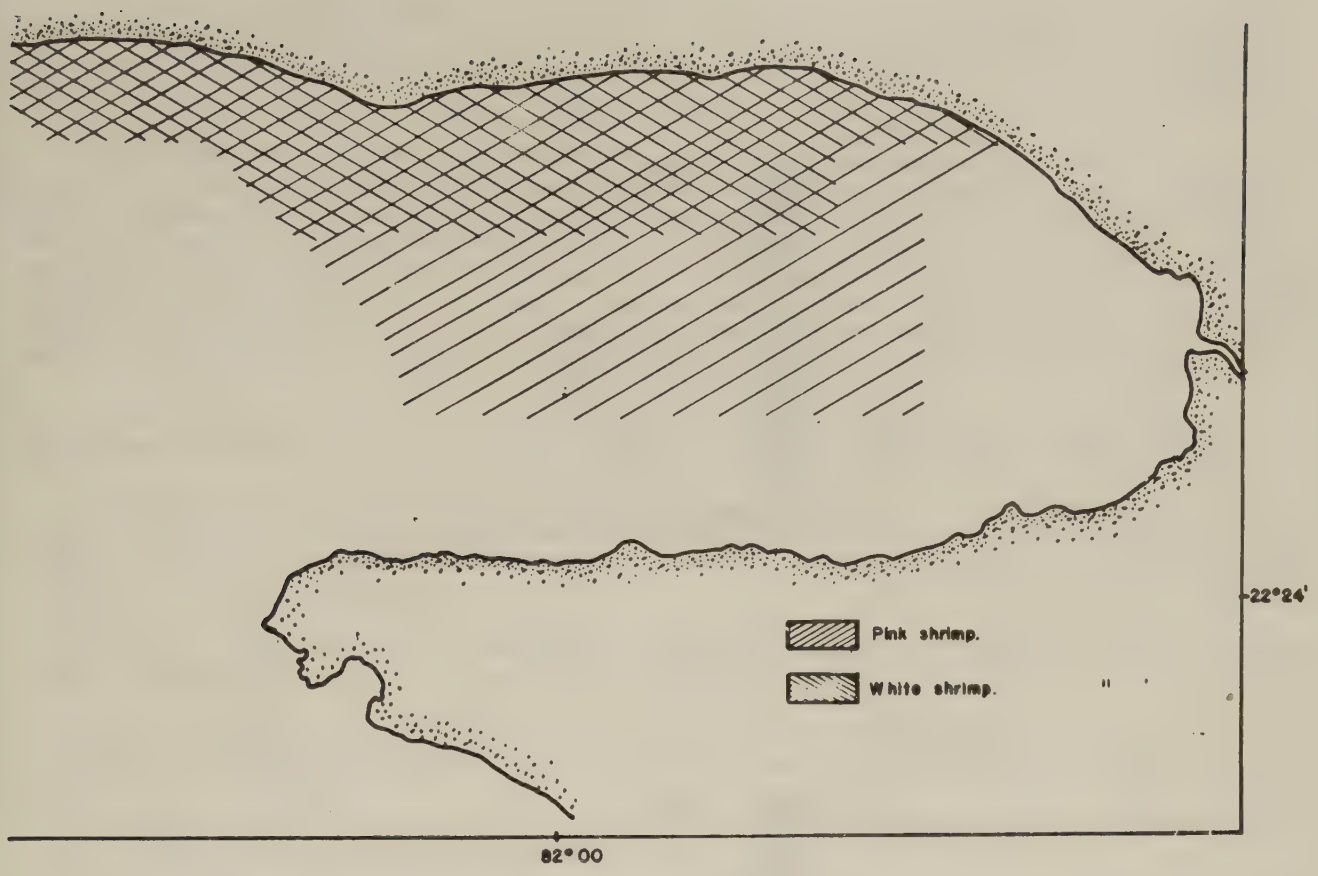


Figure 4 Distribution of white and pink shrimp in the Ensanada de la Broa

A detailed account of the fishery and a history of the management system will be given by Puga et al. (in preparation) from which most of the following has been taken.

The area has a mximum depth of 8.0 m and is situated far from the open sea surrounded by low and swampy land which provides a large freshwater input; all these features cause the basin to behave in a way resembling a very large coastal lagoon with its wide oceanographic variations and high productivity.

An outstanding feature is the complete absence of those estuaries and coastal lagoons considered typical for shrimp nurseries. Freshwater input is provided by some small channels and rivulets and the Hatiguanico River, with fast flows unsuitable for juvenile shrimp. The shrimp develop in two very narrow and small areas of shallow water near shore (Puga et al., MS) which are highly succeptible to human and environmental influence.

Since the onset of the fishery in November 1977, fishing vessels have used 25 mm mesh-size in trawls and the area has been under close surveillance so that rich data coverage for the shrimp population is available.

The faster growth rate of the shrimp and the shallow water up to one mile from the nursery grounds, which precludes trawling, assure a larger size of shrimp in catches as compared with other fisheries (Figure 5).

Exploitation began with two vessels and three vessels were fishing during 1978 when steps were taken to establish a statistical catch and effort reporting system based on 25 $n.mi^2$. The system began in 1979 and, at the end of 1980, a 9 $n.mi^2$ basis was adopted.

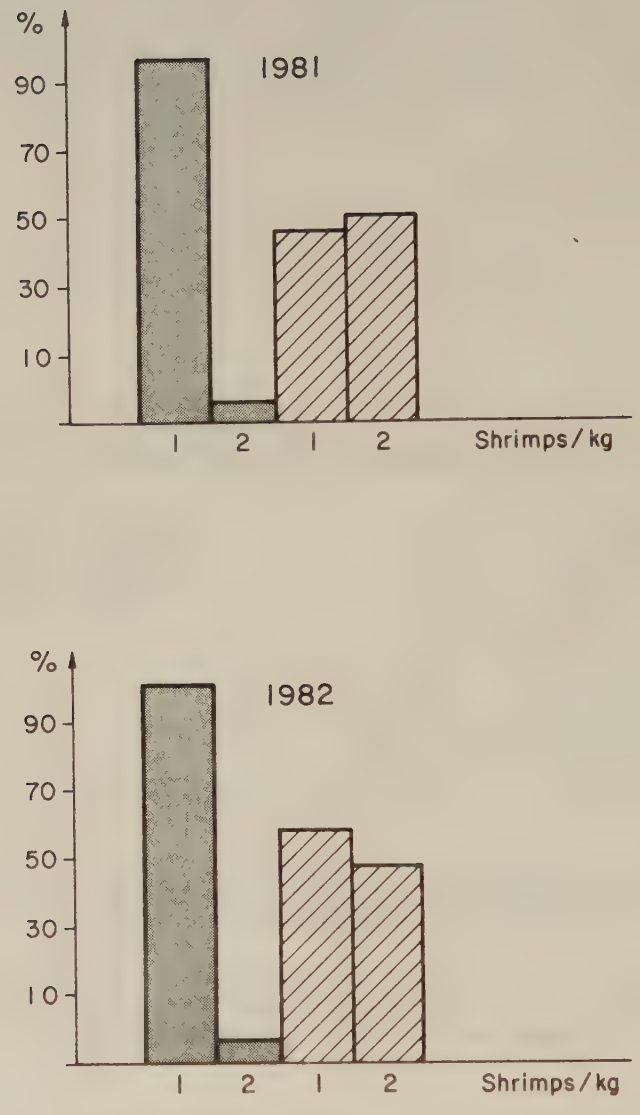


Figure 5 Percentage of large (1) and small (2) shrimp in Batabano (black) and the southeastern fishery (striped)

The spatial effort allocation analysis showed a heavy loading of effort on nearshore white shrimp, where high c.p.u.e. and size guaranteed good earnings. In 1979 five vessels worked in the area and two more began to fish in 1980, indicating that the difficulties there were to control the total effort increase, as the history of the fishery was so short and first assessments carried out by the swept-area method gave very high MSY figures (Puga and Formoso, 1978; Puga, MS). Besides the c.p.u.e. was much higher by then than in the rest of shrimp fisheries of the country.

In September 1979 occurred hurricane "Frederick", a factor which triggered a chain of actions and reactions affecting fishery management and the shrimp populations and caused a sudden drop in salinity together with a mass mortality of pink shrimp, without damage to the more eurihaline white shrimp.

Soon after the hurricane, white shrimp began to attract almost all the fishing effort and the population was being rapidly decimated. By September 1980, with the establishment of the Catch Bureau, management became more active; a coastal belt three miles wide was established and fishing was banned inside it for three months to allow white shrimp recruitment to develop and restore the population. From then on, monthly meetings were held with the fishermen in order to explain the need for seasonal and spatial effort regulation. Concomitantly a shrimp price scale was established in which size composition and c.p.u.e. by species were taken into account, in an attempt to make both species equally desirable to fishermen and to provide a better effort allocation between species.

During the last four months of 1980, effort turned towards the pink shrimp and depleted its recruitment, though stock growth had been enhanced by the delayed effects of hurricane "Frederick".

When the fishery for white shrimp started again on January 1981, c.p.u.e. was very high as a result of a very successful recruitment and there was a risk of effort over-concentration, so rigid controls and a system of vessel rotation were established allowing a specified number to fish the area during predetermined time periods.

Despite the opening of the coastal area, effort on pink shrimp seemed too high and it was decided, after much discussion, to keep it to a minimum from May 1981 onwards.

As was expected, the white shrimp c.p.u.e. decreased as the season progressed but, although the spawning stock was normal, 1981 recruitment surprisingly was a complete failure.

The crisis became evident when the depleted 1980 pink shrimp recruitment produced a lowered spawning stock and its recruitment also failed.

The fishery was stopped in November 1981 and a one-year closed season was decreed to allow both populations to recover. Monthly research cruises have shown a gradual recovery during 1982 which it seems will allow some fishing in 1983 when only four vessels will be appointed to the area.

The Ensenada de la Broa experience showed that, notwithstanding the benefits obtained by spatial and seasonal effort control and price manipulation, the two-key factors for the management of this fishery are strict control of total yearly effort and maintenance of a "buffer biomass" (Doubleday, 1976; Sissenwine, 1977) to assure a spawning potential large enough to overcome environmental fluctuations. In a very small fishing ground like the Ensenada de la Broa, such prevention becomes imperative.

The South-eastern Coast Fishery :

This area produces 96.2 percent of the total Cuban shrimp catch (Baisre, 1982). There is a number of recruitment groups from different estuarine systems along the coast (Pérez, MS) which, at least in the case of pink shrimp from the easternmost area (Manzanillo), were shown to be distinct enough in distribution, spawning areas, fecundity and growth rates to deserve to be treated as separate fishery units (Rodriguez and Pérez, 1981; Rodriguez et al., 1982) and very recent results on biochemical polimorphic proteins (Villaescusa, pers.comm.) have shown they also are genetically different groups.

Because these findings are taken into account in the general management strategy only to a limited extent, for most purposes the shrimp fishery is treated as two large populations, one in the Guacanayabo Gulf and the other in Ana Maria Gulf (Figure 1).

As is shown in Figure 6, the catch rose to a maximum in 1977 (the first maximum in 1974 was produced by the beginning of the exploitation of deeper areas) and fell continuously afterwards, while effort (in standarized fishery days) increased till 1978.

Annual catches of larger shrimp (13-58 shrimp per kg), expressed as percentages of total catch (Figure 7), show the generally increasing trend in mean size as a result of a sustained policy towards a quality increase. It exhibits a noticeable rise in 1980 as a result of the Catch Bureau's work and the added effect of a nation-wide mesh size change from 20 to 25 mm during 1981.

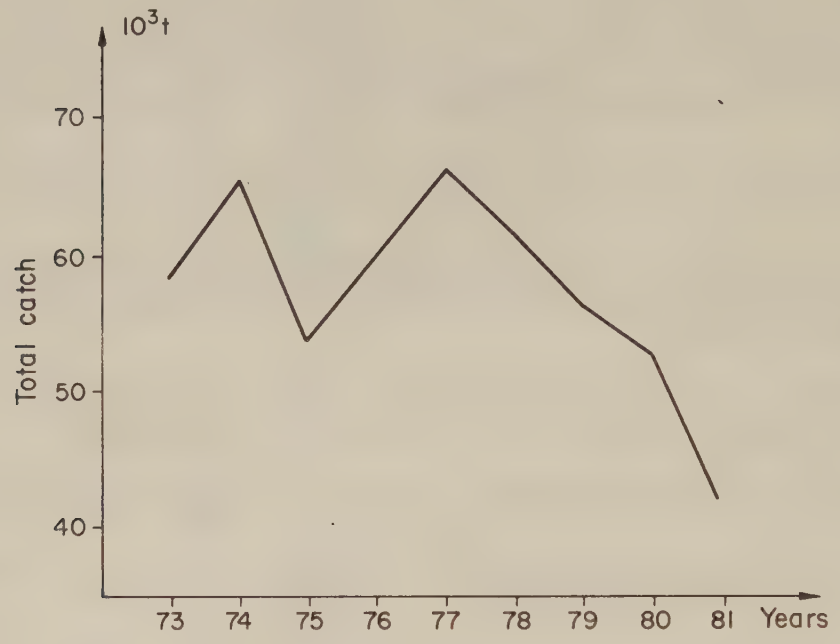


Figure 6 Annual catches from the south-eastern fishery

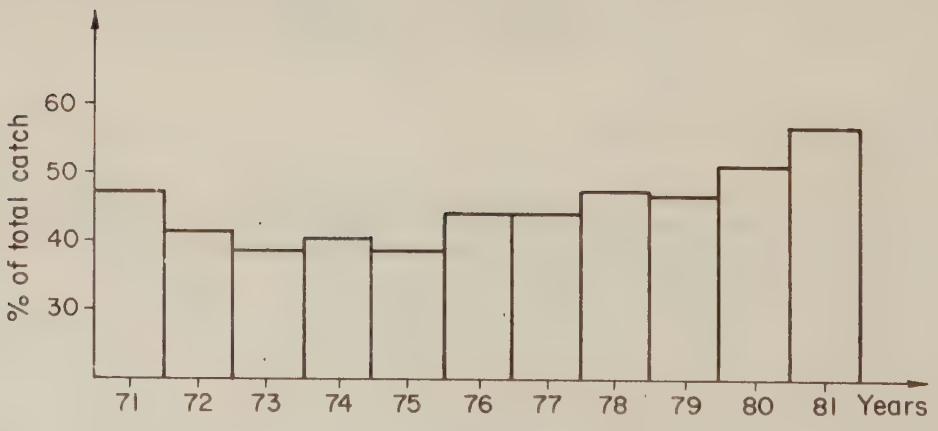


Figure 7 Annual catches of large shrimp (13-58 per kg) expressed as percentage of total catches in the southeastern shrimp fishery

The Manzanillo case :

While it is difficult to isolate the effect of individual regulations applied to the whole fishery, we expect explicitly to show its total effect in detail with the selected example of the Manzanillo fishery where most of the Ensenada de la Broa experience has been applied.

This is one of the oldest exploited shrimp areas in the country and underwent the general technological trend explained above from a coastal artisanal fishery to industrial trawling. As shown in Figure 8, total catch began to decline from 1977 onwards while effort rose.

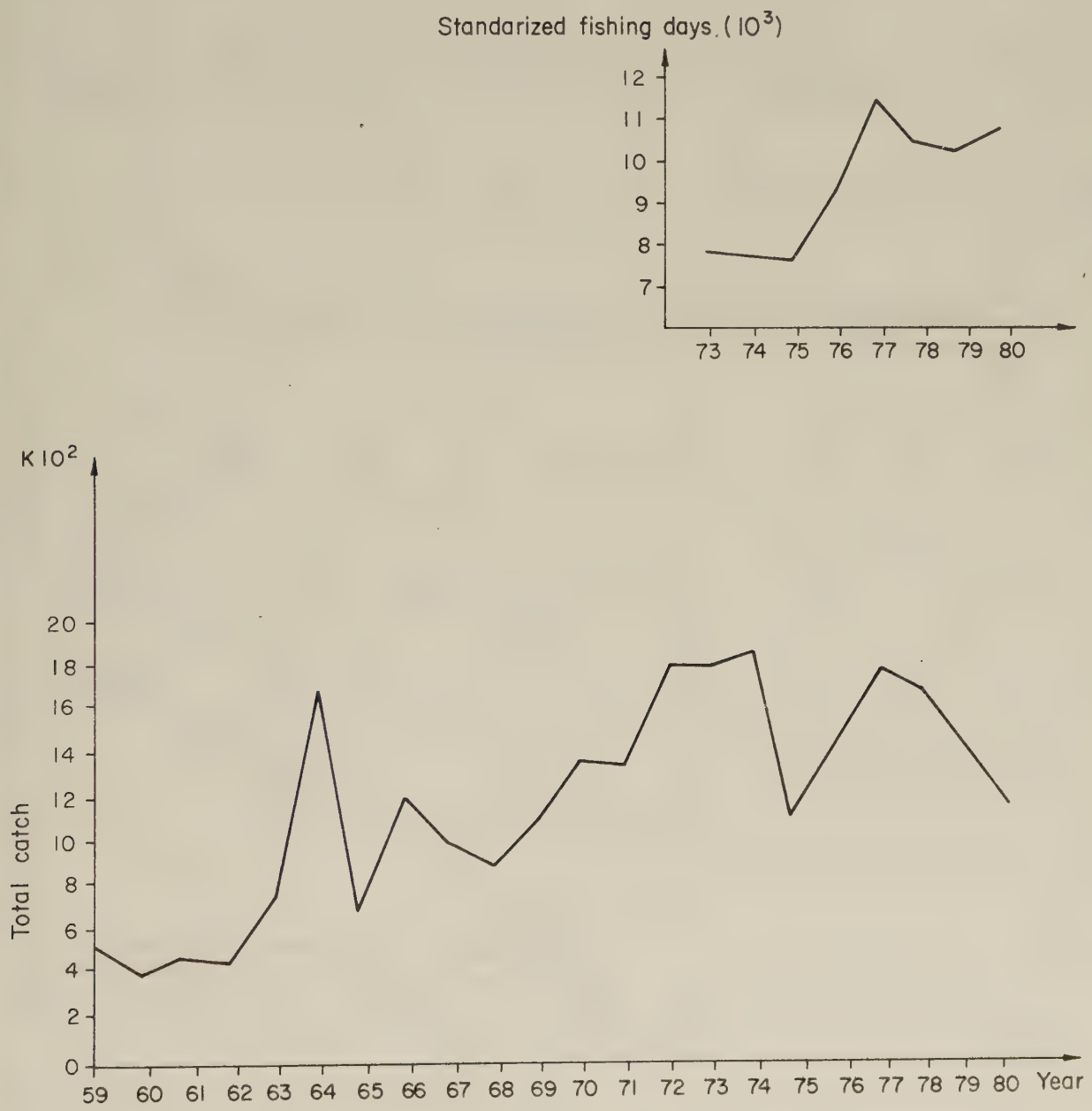


Figure 8 Catch and effort in the Manzanillo area

The Catch Bureau began to manage the fishery in December 1980 and by then an assessment of the area by structural and production models was available (Pérez et al., 1980) which showed the over-exploitated state of the fishery, the need for effort regulation and the likely results of the mesh size change implemented for this area in December 1980.

It was agreed that effort regulation must have three aspects: (1) diminishing total yearly effort level, (2) changing spatial and seasonal effort distribution, (3) showing advantages of the new mesh size and, as at least, the last two relied to a great extent on the willingness of fishermen to cooperate in enforcement, the main priority was to make them understand its need.

Regulation of total effort was approved by the Ministry of Fisheries on a step-by-step basis to allow relocation of displaced fishermen to other fisheries and, from 1980 to 1981, it was reduced by 9.6 percent.

Changing effort distribution proved to be a harder task; because most fishermen used to fish in nearshore areas where they were protected from bad weather conditions and could obtain rather large catches which, though composed mainly of small shrimp, bulk made profitable. Besides that, fishing in these deeper areas with abundant rocky patches and places of low accessibility required more skill.

To allow fishermen to operate in deeper areas, they were organized in small fleets (5 to 6 vessels) led by the most experienced skippers and the area was thoroughly marked with spar buoys and a booklet, with enlarged navigational charts of each fishing zone, was printed and distributed.

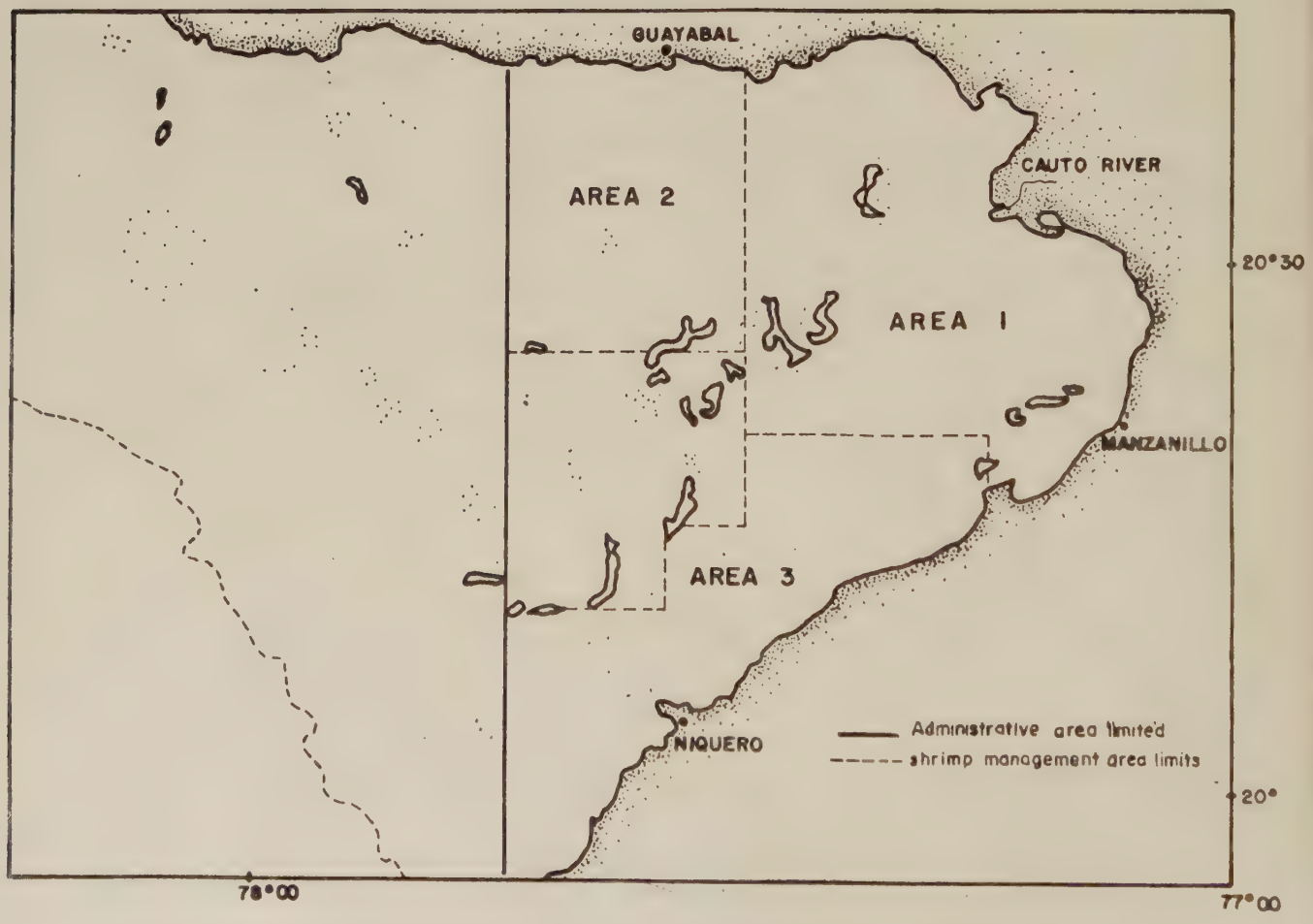


Figure 9 Manzanillo administrative area in the Guacanayabo Gulf and shrimp management areas within

Taking into account the distribution of the fishing units and their c.p.u.e., the area was split into three sub-zones (Figure 9) where small fleets rotated to minimize differences in fishermen's profits.

A further consideration was the protection of nursery areas and of sub-adults migrating into fishing grounds, making necessary the banning of night fishing in coastal areas near the mouth of Cauto River to assure proper exploitation of the white shrimp population by day fishing and lessening fishing pressure on small pinks which hide during daylight hours. Fishing effort was absolutely banned in a coastal belt 3.5 miles wide all along the management area from the middle of 1981.

As an important complement to redistribution of effort towards larger sizes, historical seasonal effort distribution patterns were assessed and found to be heavily loaded in the recruitment period (August to December) when a high c.p.u.e. in coastal areas is usually found. In 1980 the price scale by shrimp size was modified giving more weight to larger sizes; at the same time the Ministry of Fisheries has been steadily increasing the quality standards required in shrimp processing plants. All this, joined to a monthly planned effort and catch quota, favoured a progressive seasonal redistribution of fishing effort from the second to the first half of the year which was completely defined in 1981 (Figure 10).

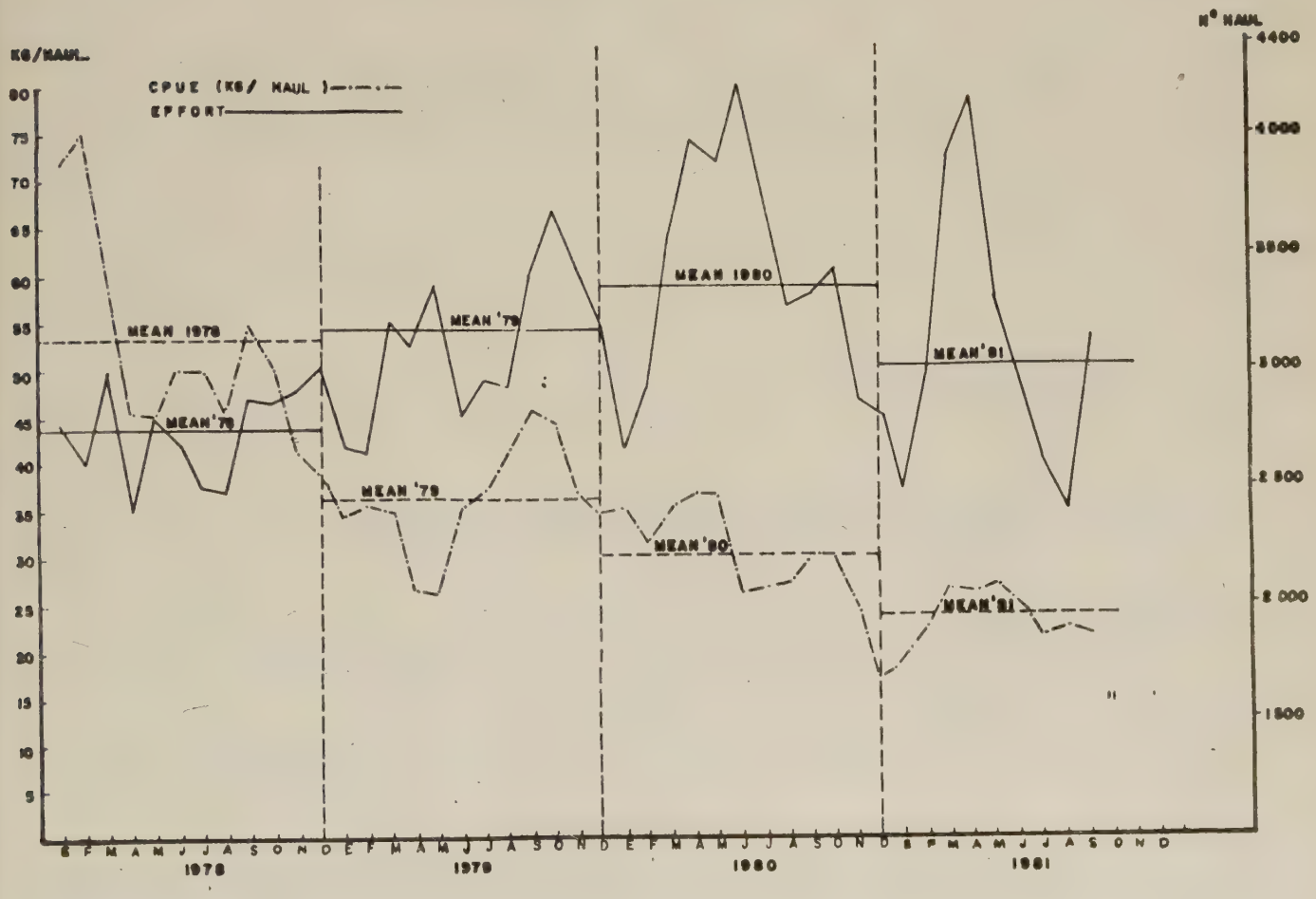


Figure 10 Seasonal effort and c.p.u.e. distribution on the Manzanillo shrimp fishery

In December 1980, the whole fleet changed simultaneously from 20 to 25 mm mesh size in trawls on account of a regulation adopted to improve size composition and to balance the high effort. The impact of this change can be detected from Figure 11 where monthly c.p.u.e. for large (13-58 shrimp per kg) and small (more than 58 shrimp per kg) is shown as percentages of corresponding months in 1980, i.e. the sharp rise in small shrimp in December 1981 due to fleet distribution. In (Figure 12) the total catch of large and small shrimp from January to September is shown for the years 1981 and 1982 as percentages of 1980 catches. It will be noticed that in 1981 the total catch diminished and that the decrease was mainly at the expense of small shrimp which could escape through the new mesh. In 1982 the population seems to have reached a new equilibrium as expected for this species (Garcia and Le Reste, 1981) with an increase in total catch mainly based on large shrimp.

It is clearly very difficult to ascertain how much of the catch increase has been due to each measure taken, but from the general picture presented it is clear that the whole system of regulations has had a strong and positive impact on this fishery.

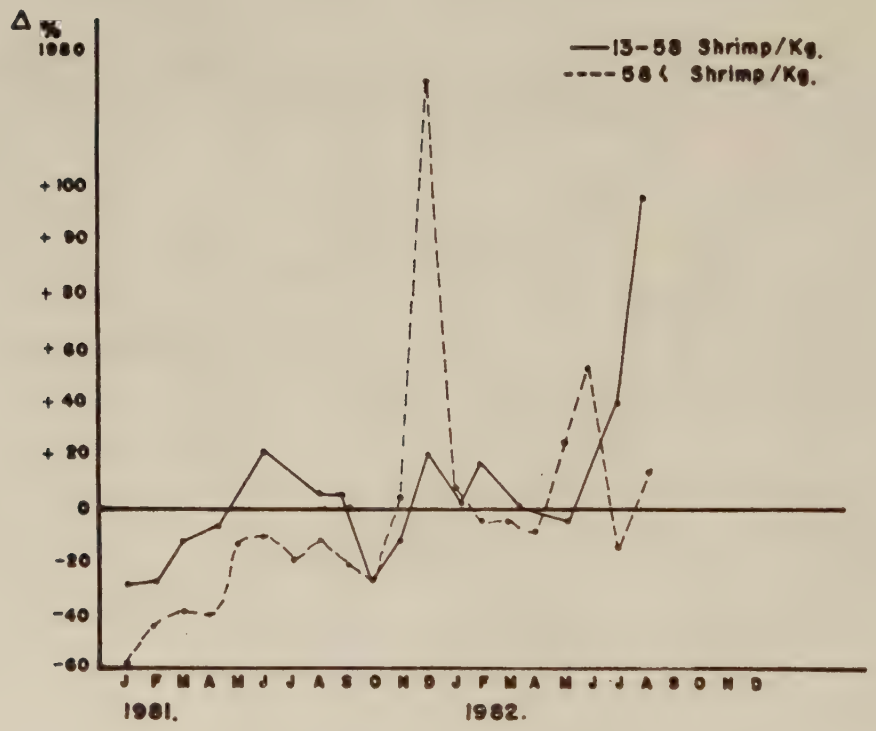


Figure 11 Observed differences in c.p.u.e. in weight of large (solid line) and small (broken line) shrimps after the increase of mesh size in Manzanillo area as percentages of the corresponding months in 1980

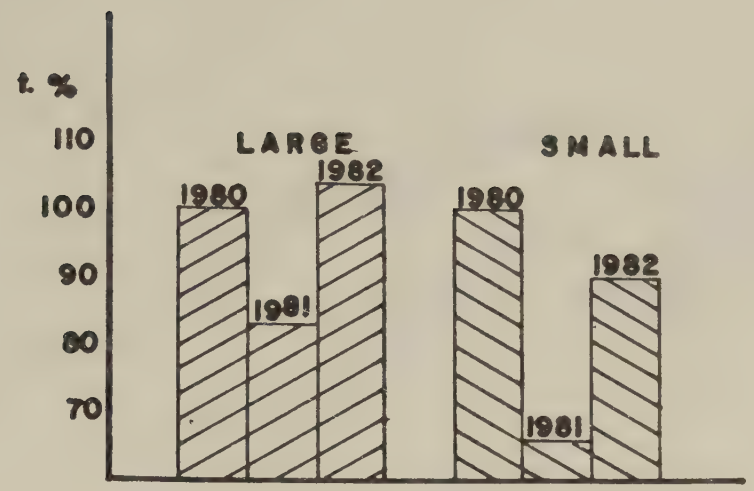


Figure 12 Catch of large and small shrimps from January to September in Manzanillo area from 1980 to 1982 expressed as percentages of the 1980's catch

3. THE LANE SNAPPER FISHERIES

3.1 Description

Like other artisanal or semi-artisanal fisheries in tropical and sub-tropical regions, lane snapper fisheries are conducted with a high diversity of fishing gears. Major fishing techniques currently used are trawling, trapping and set-netting (Baisre and Pérez, 1981). A more detailed description of fishing gears is given by Claro (1981).

Shallow waters around the Cuban south coast support more than 75 percent of the lane snapper catches, being those of the south-western region (Gulf of Batabano) the largest and most important fishing ground (Figure 13) accounting for more than 50 percent of the catches.

Catch trends are shown in Figure 14 where a positive growth may be observed until 1974 and from there on a sudden decrease because of the over-exploitation of the population on the major fishing ground in the Gulf of Batabano.

Lane snapper catches follow a marked seasonal pattern illustrated in Figure 15, with a main peak in May due to high fishing mortality during the mass spawning migration from April to June which is related to the moon's phases.

Buesa and Olaechea (1970) have determined the concentration areas where the lane snapper pre-spawning grouping takes place before the migratory movement to the spawning areas. According to Claro (1981) lane snapper migrants swim against the direction of the currents which, in the Gulf of Batabano, flow from east to west (Emilsson & Tapanes, 1971), spawning taking place on the edge of the shelf. About one month later fish larvae are carried back to the shelf aided by currents (R. Claro, pers.comm.) (Figure 16).

Figure 13 Distribution of lane snapper catches (in %) in the four shelf areas (Average from 1976-1980)

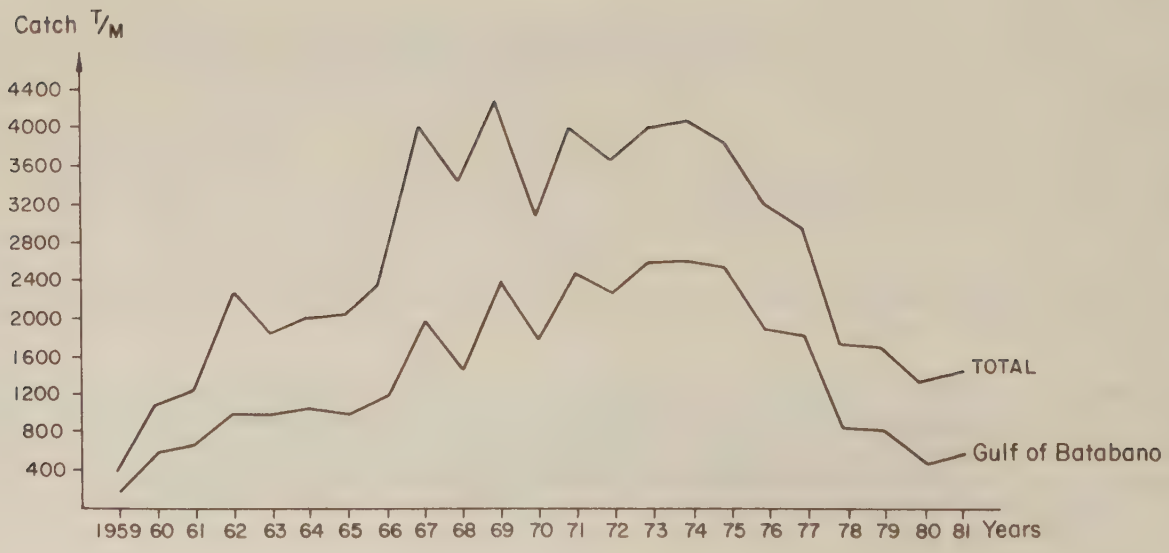


Figure 14 Yearly total and Gulf of Batabano catches of lane snapper from 1959 to 1981

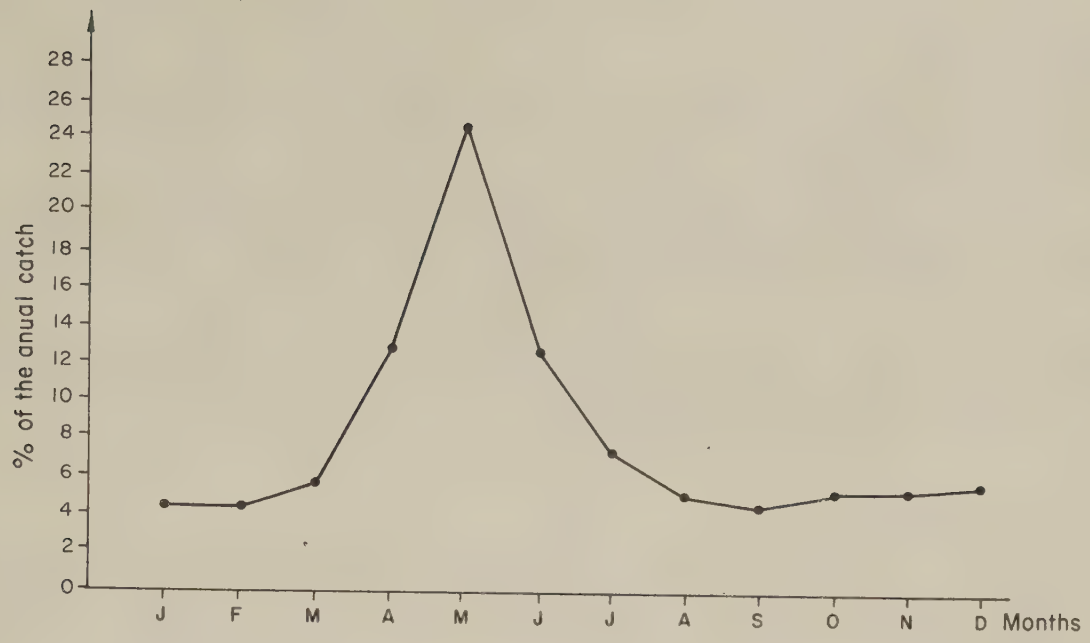


Figure 15 Monthly catches of lane snapper as a percentage of the annual catch (Average from 1962-1981)

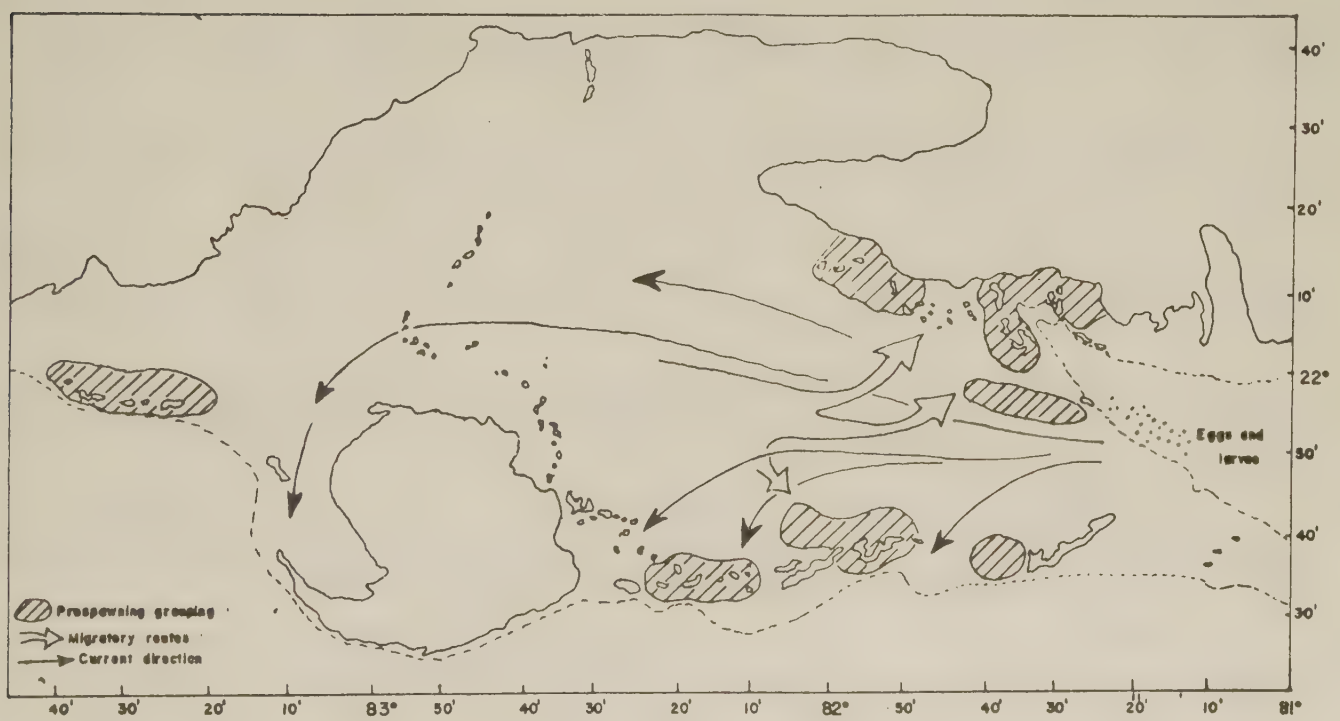


Figure 16 Spawning migration of lane snapper in the Gulf of Batabano (data from different sources)

3.2 Exploitation state

Until 1978 MSY estimates from stock assessments in the Gulf of Batabano were between 2,900 and 3,700 tons per year (Baisre and Paez, 1981) and a 3,090 t MSY was calculated in the latest assessment by Carillo (1979).

As shown in Figure 14, the catches from the Gulf of Batabano have never reached the lowest MSY estimate and despite this the species seems to be over-exploited, as indicated by the sudden decrease in the catches from 1975 onwards.

Unrealistic estimates of MSY, together with the lack of regulations, have been the main factors in this situation. Inaccuracy in measuring the effective effort, together with lack of information on stock-recruitment relations, were probably the reasons why stock assessments produced such results. Regulatory measures will be discussed below.

3.3 The management system

Basic assumptions are that there is only one self-sustained stock in the Gulf of Batabano and that effort regulation by seasonal closures during the mass spawning period is not feasible, because it would represent stopping the fishing activity when catches and c.p.u.e. are at their highest. Consequently, the regulation of fishing effort during the spawning season by quota allocation has recently become one of the most important goals in the management system for the lane-snapper fisheries.

3.4 Regulation of fishing effort

Seasonal closures were the most important fisheries regulation after 1959 but, unfortunately, they were interrupted after 1966 (Figure 17).

In recent years (1981-1982), as detailed below, regulations have been more elaborate, having included, besides quotas, some other measures like area closures on nursery grounds and a minimum legal size.

In 1981 the setting of a 135-t catch quota for the three vessels allowed to fish in the area is shown in Figure 18. The small "window" opened to the three vessels was agreed to in order to achieve a proper control of fishing effort and catch and to assess the state of the population by conducting an intensive sampling programme.

In 1982 the quota was raised to 250 t to be taken with three set nets inside the "window" together with any number of trawls outside it. A sampling and tagging programme was also carried out.

Another important fact to be taken into account is the number of under-sized fish caught during fishing operatioins with set nets, so a selective device which allows a 75-percent escapement of under-sized fish (Figure 19) (Obregon et al., 1981) will be introduced on every vessel from January 1983.

Figure 20 shows how the grey snapper (Lutjanus griseus) catch, a closely-related species, has increased during the period that lane snapper began to decline - the c.p.u.e. for the last three years also showing the same trend. As a 93.1 percent diet-overlap between them has been found (Voldés and Silva, 1977), research work for interactions between species must be undertaken.

Notwithstanding this situation and that a full impact assessment of the regulatory measures applied is not yet feasible, due to the species life span and the age at first capture (2-3 years old), it is thought that the set of regulations enforced together with the new selective device are sufficient to allow full recovery of the population from 1984 onwards.

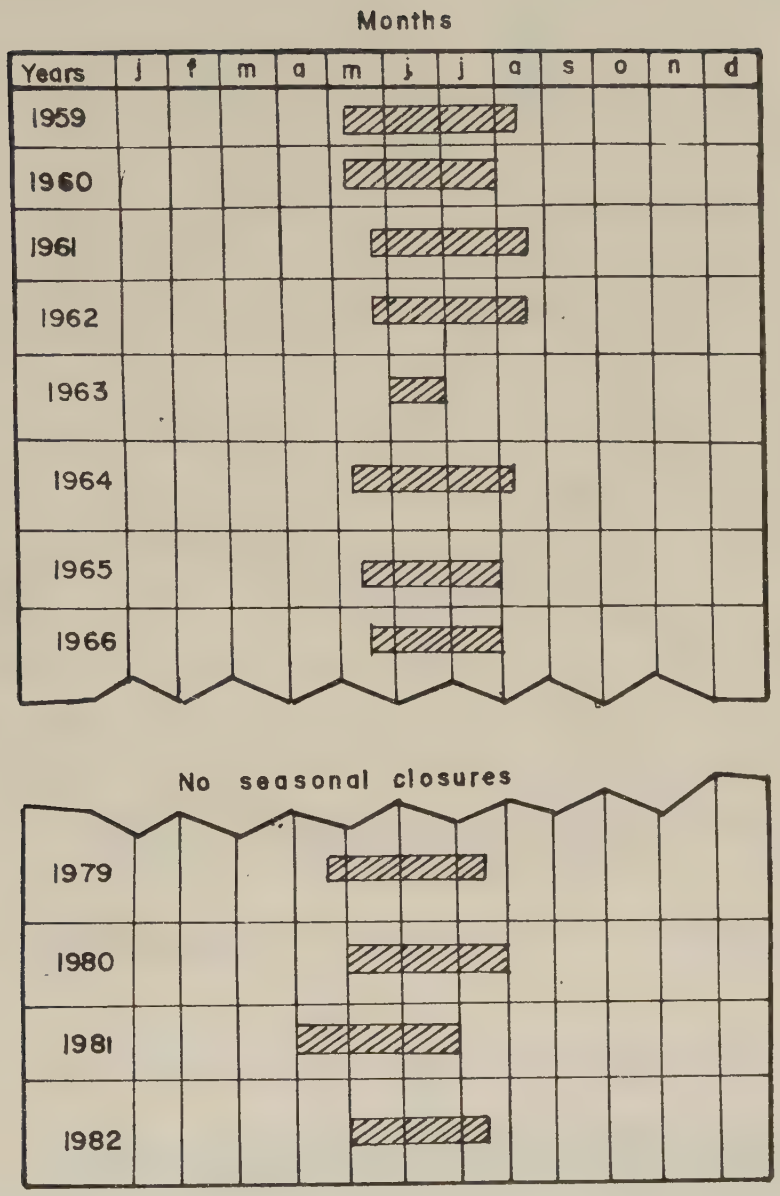


Figure 17 Seasonal closures for the lane snapper fisheries

Figure 18 Map of the Gulfof Batabano showing the area where a "window" was open for quota fishing during 1981 and 1982

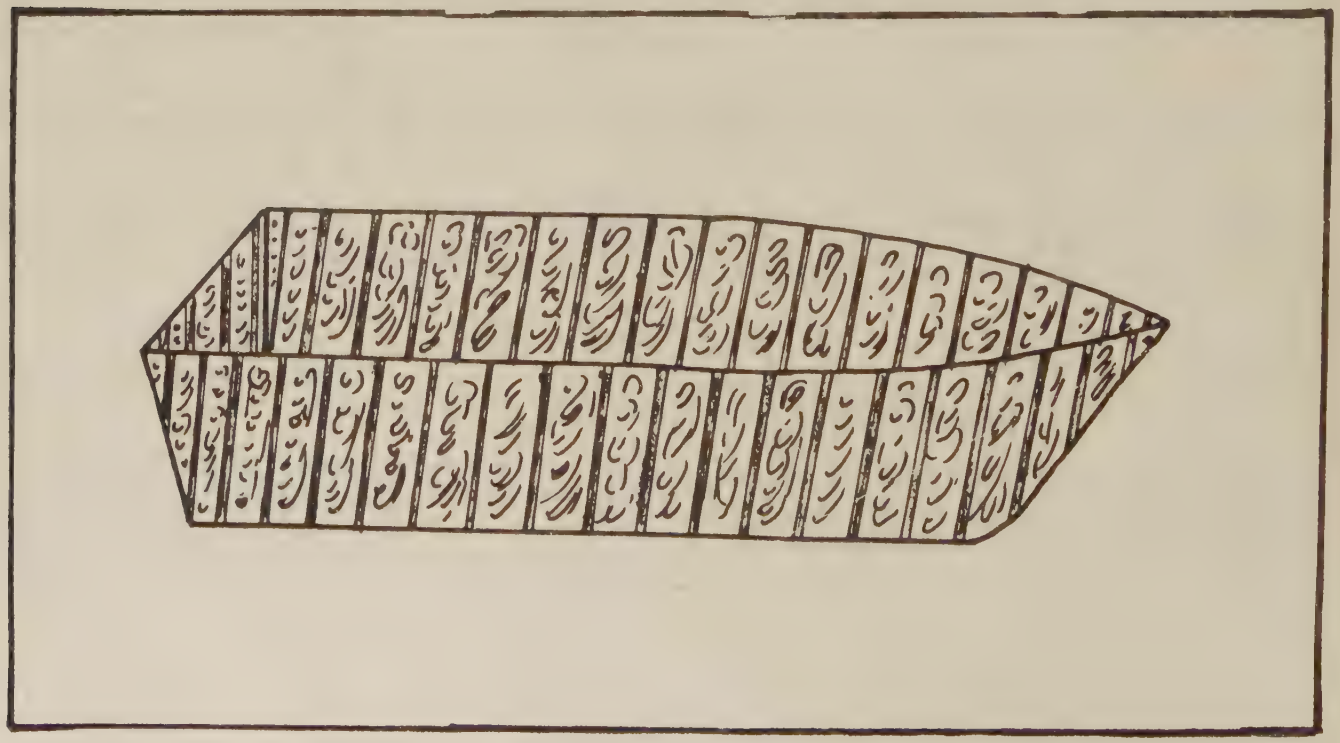


Figure 19 Boat shaped selective device to allow escapement of under-sized fishes

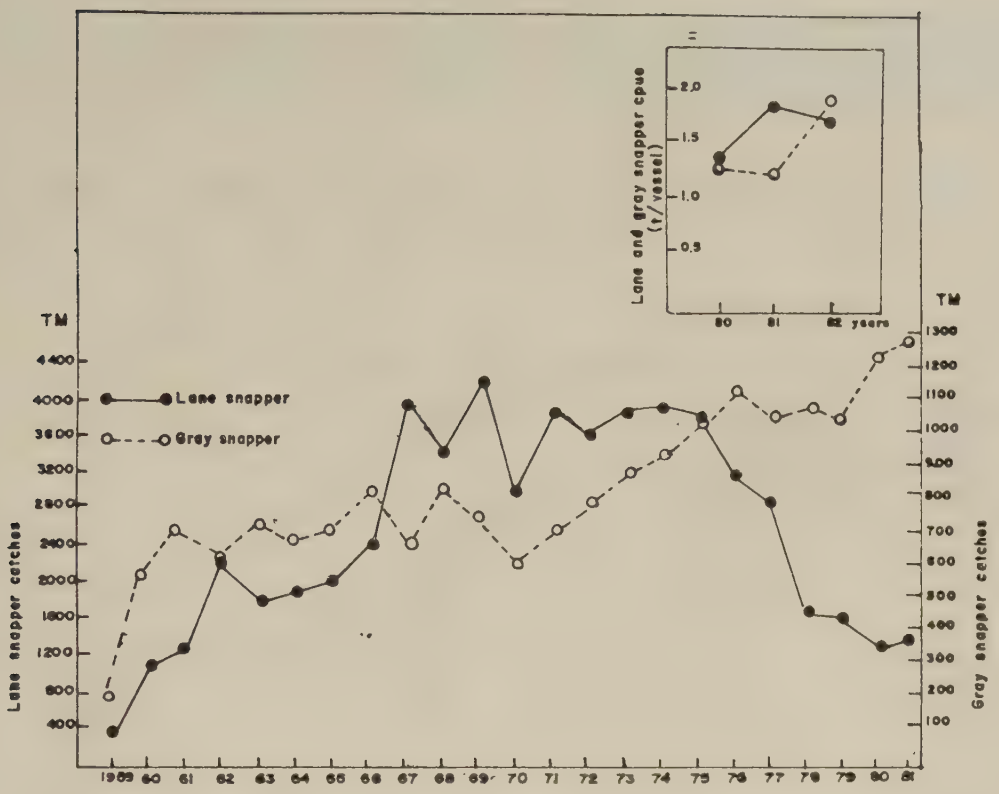


Figure 20 Catch trends of lane and grey snapper from 1951-1981. The small square shows the c.p.u.e. for both species.

4. THE SPINY LOBSTER FISHERIES

4.1 Description

Commercial fisheries for spiny lobsters began in the 1930s when the first processing plant was established at La Coloma, Pinar del Rio (Martinez, 1948).

Fishing gears have experienced several changes in the last two decades. Bully nets and Antillean S-traps were predominant until the end of the 1960s when they were replaced by different and more efficient fishing systems.

Spiny lobsters are currently fished using artificial shelters (pesqueros) together with trawl nets (chinchorros) handled by divers. A different fishing technique has also been used during the autumnal mass migration in October and November. Trap-like gears made with chicken wire and with large nets attached at the two front corners in a V pattern are placed singly or severally together in zig-zag pattern during the migratory season.

Spiny lobsters are widely distributed in all shallow-water areas with sea-grass beds and coralline growth on sandy or rocky bottom but the fisheries are more important on the south coast which accounts for 85 percent of the total catch (Figure 21).

Landings follow a seasonal pattern which is presented in Figure 22. A catch decline in February and March is followed by a closed season (usually between March and June) and then a sudden rise in June. Later on we have a small drop from July to September before reaching the main peak in October and November when migrating lobsters are mass trapped.

Figure 21 Major spiny lobsters fishing areas showing the average catch (as percent of the total catch). (Data from 1976-1980)

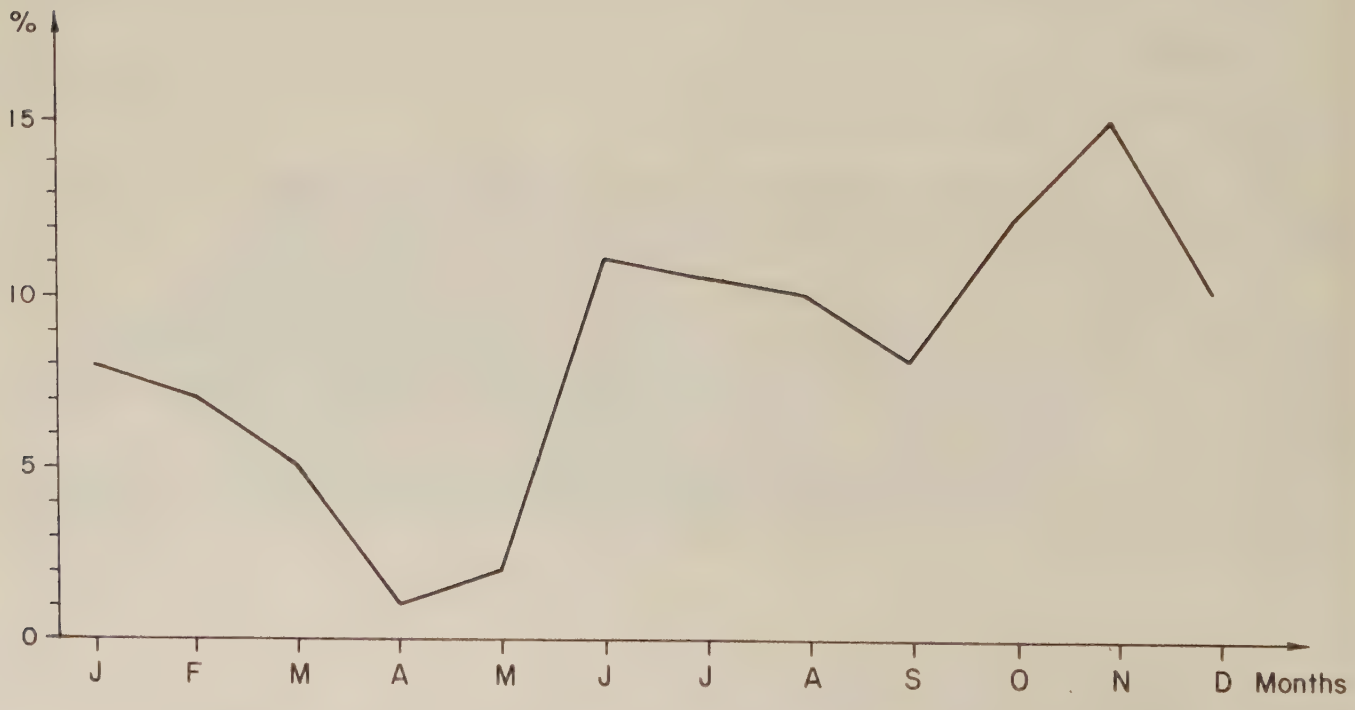


Figure 22 Seasonal trend of spiny lobster catches (average from 1962-1981)

4.2 Exploitation state

Spiny lobsters are intensively exploited not only because of their accessibility to the fisheries but also due to the high prices for lobsters in the world market.

Before 1978, the MSY for spiny lobster stocks was calculated at around 9,000 t per year (Bairse and Paez, 1981). At present stock assessments are difficult because the effective effort is unknown due to the fact that artificial shelters are under water during several months and fished irregularly. Accurate age determinations from VPA analysis is not available either.

Data on length composition for the lastest years (Figure 23) show, however, that a high percentage of the catch is derived from the newly-recruited lobsters (between 20 and 24 cm total length), which is indicative of the high fishing pressure that has been exerted upon the resource.

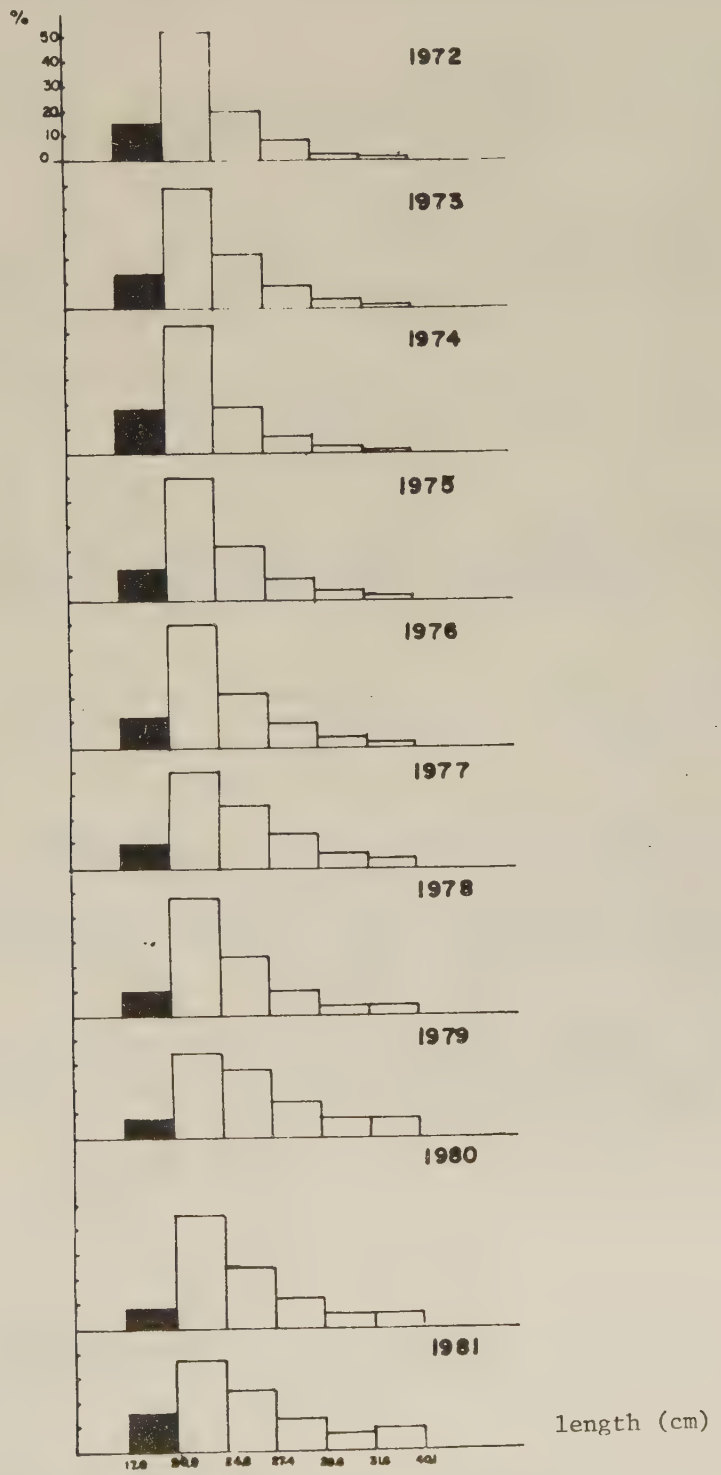


Figure 23 Size composition of spiny lobster landings (data from processing plants)

4.3 Management system

The management system for spiny lobster fisheries is primarily based on the assumption that stocks are essentially self-sustained and external recruitment is not of significant importance in the maintenance of the lobster population.

Arguments which support this view are that the over-exploitation of spiny lobsters in Brazil, the only important lobster ground in the south Caribbean, has not had a noticeably adverse impact on Cuban fisheries. Responses to regulation measures, which will be discussed below, are also an indicator that the self-sustenance hypothesis holds true.

4.4 Regulation of fishing effort

The most important regulations for spiny lobster fisheries are the minimum legal size and the closed season. Other restrictions are the prohibition on the catch of oviferous females and on spear-fishing.

Because spiny-lobster stocks are at the limit of their reproductive elasticity, minimum legal size measures have been designed primarily to enable the lobsters to reach sexual maturity in order to preserve the stock's reproductive capacity. The minimum legal size is 21 cm total length (about 6.6 cm length of cephalothorax), measured from the middle of the antennae to the tip of the telson.

Because recruitment to the fisheries occurs at lower sizes but close to the minimum legal size, juvenile lobsters are usually caught in artificial shelters and therefore these measures have also a positive secondary effect of protecting recruitment.

A closed season for lobster fisheries has been established since 1959, the duration and also enforcement being different from year to year. In Figure 24, three different periods might be observed: in the first one from 1959-1967 the closed season had a mean duration of three months (91 days), the second period from 1968-1977 had a mean of two months (58 days) and finally the last period had a duration of slightly more than three months (97 days).

The figure also shows the average c.p.u.e. for the first two months of the open season reaching its highest level (30 t/fishing day) when the closed season averaged more than three months. This rise in the c.p.u.e. is related not only to the lengthening of the closed season but also to a legal minimum size with strict enforcement on both. Closed-season duration is positively correlated ($r = 0.639$) (Figure 25) with the c.p.u.e. two months after the beginning of the open season.

The three periods mentioned above are also in agreement with the catch trend shown in Figure 26. From 1959 to 1967 there was a progressive increase in the catch until it reached about 9,000 t at the end of the period. From 1968 until 1977 the catch averaged 9,020 t and the trend was more regular. From 1978 onwards not only was the closed season extended but also enforcement was improved and control of the legal minimum size became more strict. As a positive consequence of such regulatory measures, catches from 1978-1981 have risen progressively, averaging 10,507 tons.

Although a concomitant effort increase might also be responsible for the higher yields of later years, there is no doubt that the higher c.p.u.e. after the closed season, the increase in the average size (Figure 27) and in the larger size groups (as shown in Figure 20) support the idea that regulatory measures were the main factors involved.

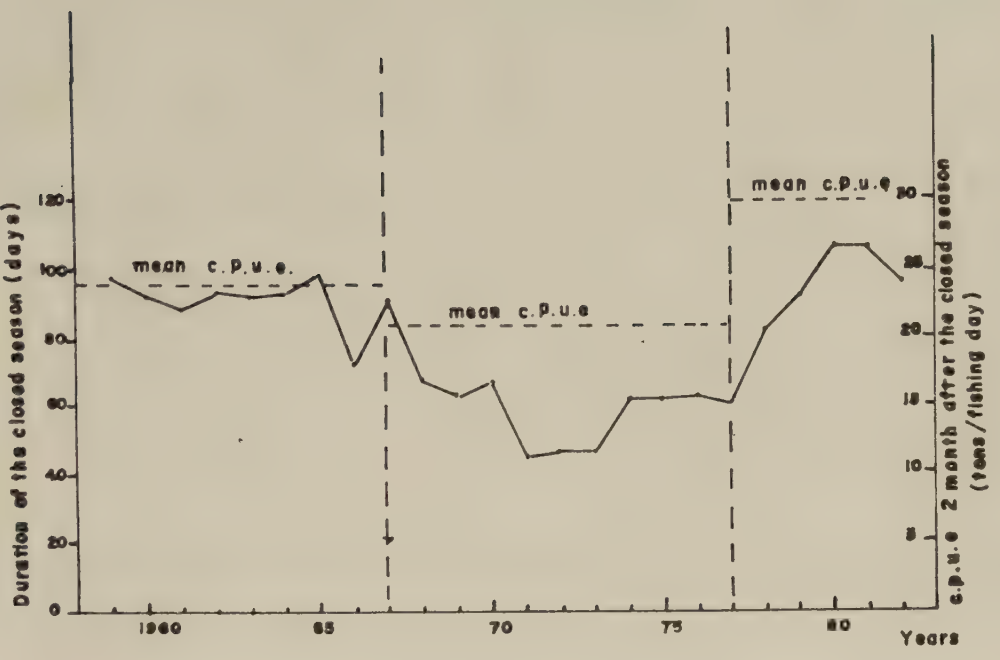


Figure 24 Closed season duration from 1959 to 1981 showing the average c.p.u.e. obtained during 3 different periods

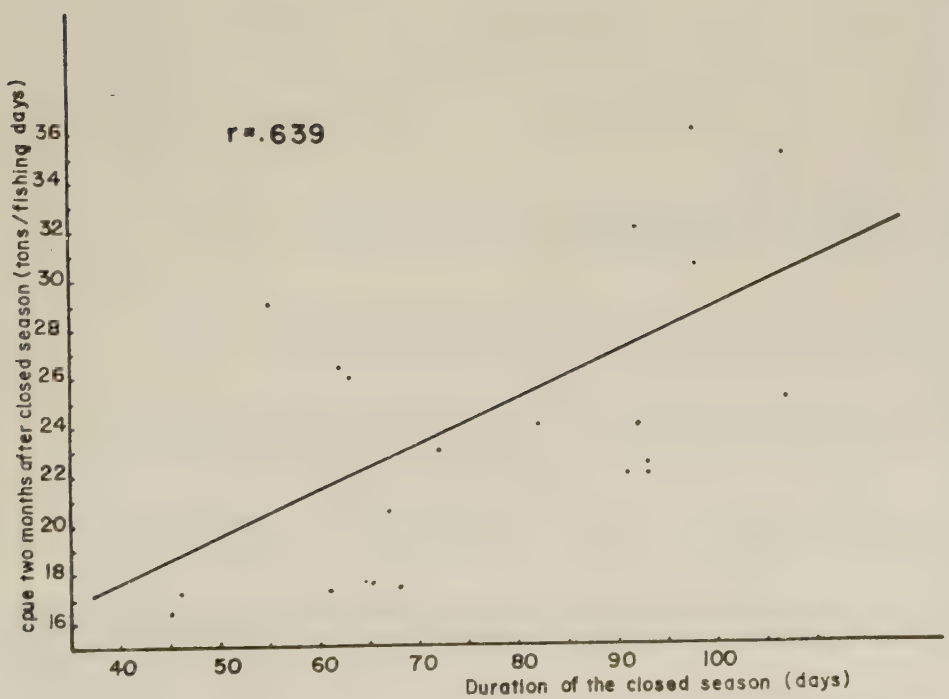


Figure 25 Correlation between the duration of the closed season and c.p.u.e. two months after the opening of the fishing season.

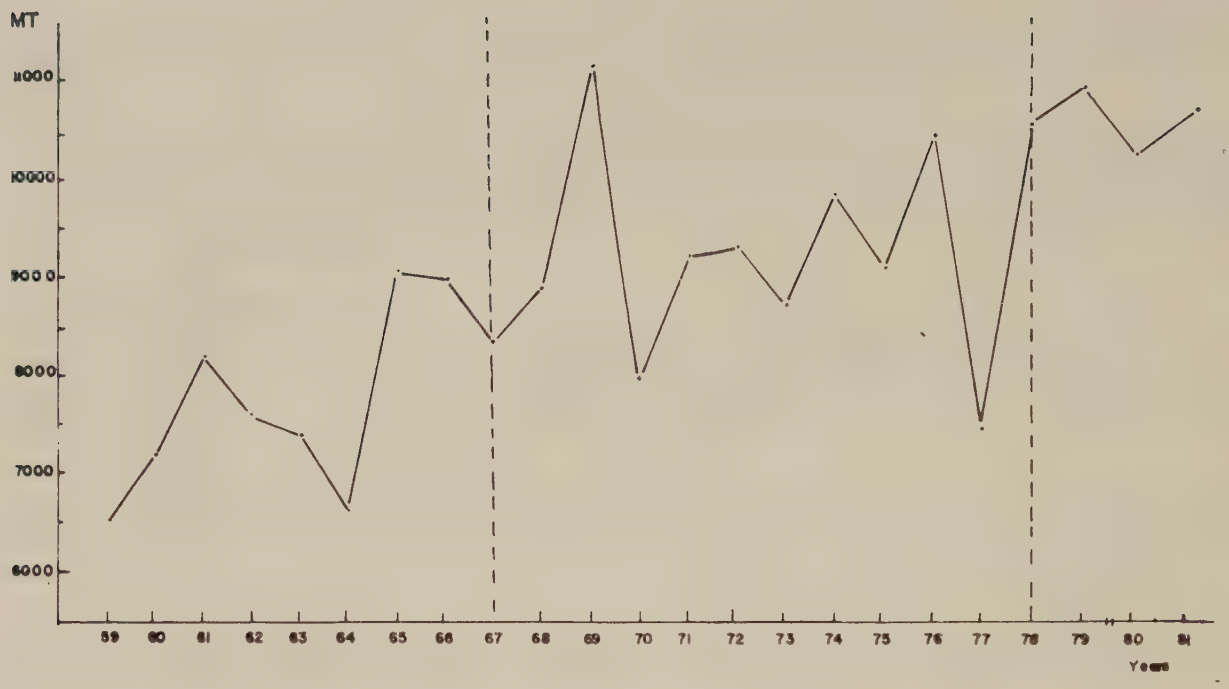


Figure 26 Catch trend of spiny lobster from 1959 to 1981. Three different periods are established according to the duration of the closed season.

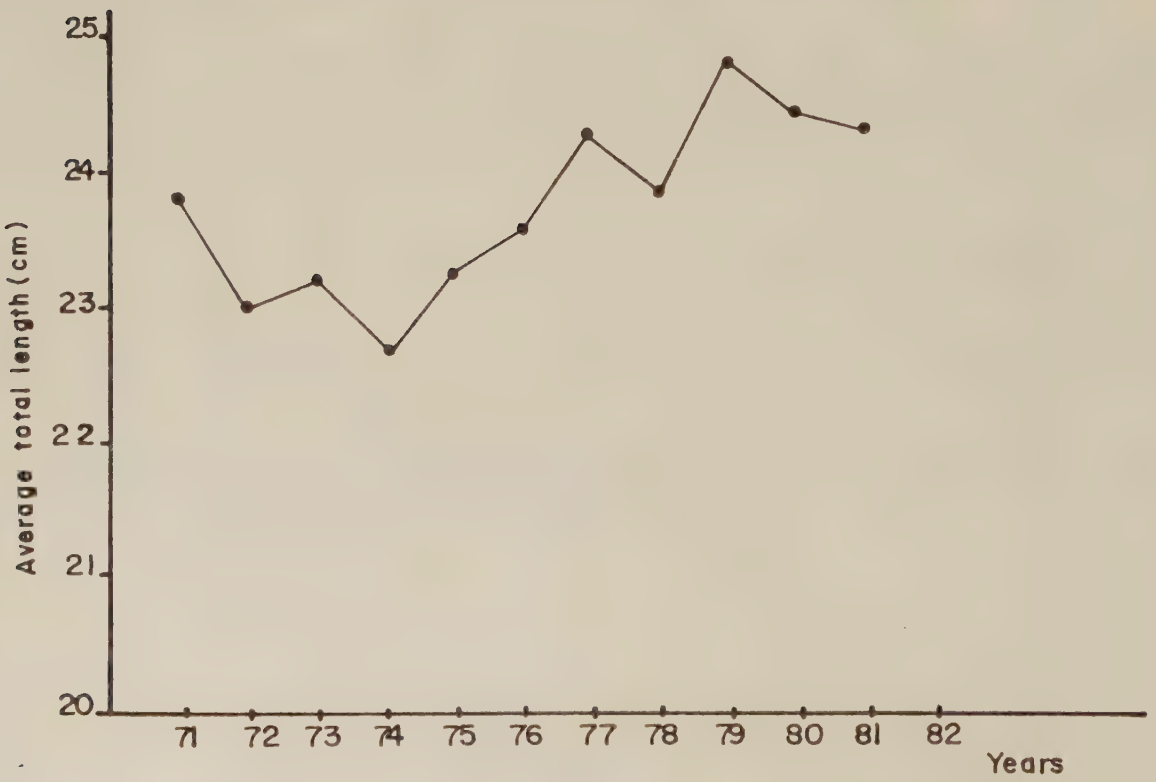


Figure 27 Mean size of spiny lobsters (data from processing plants)

REFERENCES

Baisre, J.A., 1982 Resultados de la administración científica de las pesquerías de camarones (Penaeus spp.) y langosta (Panulirus argus) en la plataforma Cubana. Documento presentado a la III Reunión del Grupo de Trabajo de la COPACO sobre evaluación de recursos pesqueros marinos. Kingston, Jamaica, 17-21 de marzo de 1982

Baisre, J.A. and J. Páez, 1981 Los recursos pesqueros del archipiélago Cubano. WECAF Stud., (8):79 p.

Buesa, R.J. and A. Alaechea, 1970 Estudios sobre la biajaiba: zona B y áreas de Diego Pérez. La Habana, Cuba, INP/CIP, 25 p. (mimeo)

Carrillo, C., 1979 Estado de la pesquería de la biajaiba (Lutjanus synagris) en la plataforma suroccidental de Cuba. Rev.Cub.Invest.Pesq., 4(4):42 p.

Claro, R., 1981 Ecología y ciclo de vida de la biajaiba, Lutjanus synagris (Linnaeus), en la plataforma Cubana. II. Biología pesquera. Inf.Cient.Téc.Inst.Oceanol.Acad.Cienc.Cuba, (177): 53 p.

Doubleday, W.C., 1976 Environmental fluctuation and fisheries management. Sel.Pap.ICNAF,(1):141-50

Emilson, I. and J.J. Tápanes, 1971 Contribución a la hidrología de la plataforma sur de Cuba. Ser.Oceanol. Inst.Oceanol.Acad.Cienc.Cuba, (9):31 p.

García, S. and L. Le Reste, 1981 Life cycles, dynamics, exploitation and management of coastal penaeid shrimp stocks. FAO Fish.Tech.Pap., (203):19 p.

Martínez, J.L., 1948 Cuba's spiny lobster industry. Fish.Leafl.U.S.Fish Wildl.Serv., (294):19 p.

Obregón, M.H., I. Ramos and F. Pérez, 1981 Resultados de la experiencia de selectividad con viveros seleccionadores. Resúmenes III Foro Cient.del CIP, October 1981

Pérez, A., Zonas de cría y vías probables de reclutamiento del camarón en la costa suroccidental de Cuba. Archivo,Centro de Investigaciónes Pesqueras, Cuba, Diciembre 1980 (MS)

_____, 1982 Bioeconomía, administración pesquera. En Mesa redonda sobre camarón "características de las pesquerías y la dinámica poblacional del camarón en Cuba". Publ. Centro de Inv.Pesq., Julio 1982

Pérez, A., R. Puga y G. Venta, 1981 Bioeconomía de la explotación de los recursos camaroneros. In Resúmenes, Primer Congreso Nacional de Ciencias Biológicas, 29-30 de Octubre de 1981, La Habana

Pérez, A., G. Venta y R. Puga, 1981 Dinámica de la pesquería mixta de camarón en el área de Manzanillo. Resúmenes. III Foro Científico del Centro de Investigaciónes Pesqueras, Octubre 1981

Pérez, A. et al., 1980 Resumen general de las pesquerías de camarón de la plataforma Cubana. Documentados presentados por el Centro de Investigaciónes Pesqueras a la I Reunión Nacional de Camarón. Cuba, Topes de Collantes, 5-6 Septiembre 1980

Pérez, A. et al., 1981 Documento de la Primera Reunión Anual del Consejo de los Buroes de Captura de Camarón para la II Reunión Nacional de Camarón, 16-17 Septiembre 1981

Pérez, A., et al., 1981a Tendencias administrativas actuales y posibles acciones sobre la pesquería de camarón en Cuba. Archivo, Centro de Investigaciónes Pesqueras, Enero 1981 (MS)

Pérez-Farfante, I., The discovery of new shrimp bank at Golfo de Batabanó, Cuba. Proc.Gulf
1954 Caribb.Fish.Inst., 6:97-8

_____, El primer año de la pesca del camarón en aguas Cubanas. Proc.Gulf Caribb.Fish.Inst.,
1955 7:181-3

Puga, R., Resultados preliminares de las investigaciones pesqueras de camarón en la Ensenada de la
1979 Broa. Archivo,Centro de Investigaciónes Pesqueras (MS)

Puga, R. y M. Formoso, Situación actual de la pesquería exploratoria de camarón en la Ensenada de la
1978 Broa. Primero Foro Científico del Centro de Investigaciones Pesqueras, 3 p.(mimeo)

Puga, R., A. Pérez y G. Venta, Desarrollo del sistema administrativo en la pesquería de camarón de la
Ensenada de la Broa (en preparación)

Puga, R., G. Venta, A. Pérez y S. Alfonso, Características de la etapa juvenil de Penaeus notialis y
1982 Penaeus schmitti en relación con su ciclo vital en la Ensenada de la Broa. Archivo,
Centro de Investigaciónes Pesqueras, Cuba, Mayo 1982

Rodriguéz, J. y A. Pérez, patrones de migración y definición de unidades pesqueras de camarón en el
1981 área de Manzanillo. Resúmenes, Primero Congreso Nacional de Ciencias Biológicas, 29-
30 de Octubre de 1981, la Habana, 7 p. (mimeo)

Rodríguez, J., M. Morenza y A. Pérez, Relaciones largo-edad en unidades pesqueras de camarón
1982 rosado y blanco en el área de Manzanillo. Resúmenes VI jornada científica del Instituto
Oceanología, Academia Ciencia, Cuba, 32 p.

Sissenwine, M.P., The effect of random fluctuations on a hypotetical fishery. Sel.Pap.ICNAF,(2):137-
1977 44

Valdés, E. y A.F. Silva, Alimentación de los peces de arrecifes artificiales en la plataforma
1977 suroccidental de Cuba. Inf.Cient.Téc.Inst.Oceanol.Acad.Ciencias,Cuba, (24):21 p.

FISHERIES MANAGEMENT OF LAKE KINNERETH

by

M. Bar Ilan
Fisheries Department
Ministry of Agriculture
Israel

Ancient Management Records

The first recorded fisheries management on Lake Kinnereth - Lake Tiberias - was then the tribes of Israel came into the land of Canaan in 1300 B.C., and the main fishing rights were rendered to the inhabitants of the north-western shores of the lake: the tribe of Naftali. Other tribes, on the southern shores, received only minor fishing rights. It is an interesting fact that, already at this early period, determination of fishing rights was expressed in terms of fishing methods.

This division and the regulations were either issued by or ascribed to Joshua, as follows: "And it is allowed (to other tribes) to fish by hooks on the sea of Tiberias but not to throw cast net and not to steady the boat (meaning: beginning to set a shore seine) and it is also allowed to set traps. It was agreed by the tribes that the sea of Tiberias belongs to Naftali" (who had the main fishing rights: shore seines and cast nets).

The Lake

The 170 km^2 lake is situated in the Syrian-African Rift Valley, 209 to 212 m below sea level. Water temperature is 14-C to 28-C and the maximum depth is 42 m.

The lake's indigenous fish population consists mainly of two Sarotherodon species, Tilapia and Tristramella, three species of barbel, Kinnereth bleak (Mirogrex terrae sanctae), catfish and some non-commercial fishes. Grey mullet and silver carp are stocked continuously. Common carp has been introduced sometimes in the past but never assumed an important share in the catches.

The average annual catch in the last decade is 1,800-2,000 t, i.e. approximately 117 kg per hectare. Productivity of the lake is limited by stratification, long seasons of lack of oxygen and stagnation in the hypolymnion with only a few months of full water circulation and saturation of oxygen throughout all water layers.

Composition of Annual Catch

1980 - as a representative year	**tons**
Sarotherodon galileus and S. aureus	392
Tilapia sp. and Tristramella sp.	164
Barbus sp.	155
Mirogrex terrae sanctae (Kinnereth sardines)	852
Mugil sp. (grey mullet)	181
Carp	37
Clarias lazera (catfish)	11
Hypophthalmichthys molitrix (silver carp)	187
Total :	1,979

Fishing Methods

There are two main fisheries: (a) Purse seining, supported by seven 10-12 m boats using 250 m purse seines and equipped with power blocks and acoustic fish finders. Each operates with 4 to 5 auxiliary lamp boats. They fish mainly Kinnereth bleak but approximately 20 percent of their effort is aimed at larger fish: Sarotherodon, Tilapia, grey mullet, Barbus and silver carp. (b) An artisanal fishery, supported by 4-6 m open boats, outboard-motor driven, using fleets of 10 to 20 2-m deep trammel nets, fleets of 10 to 20 driftnets or fleets of 20 to 40 4-6 m deep gillnets. Most recently 6-9 m deep trammel monofilament nets have been introduced and are used either as bottom-set or driftnets. In 1981, 90 fishing units used these nets.

This new development has upset the traditional division between the offshore purse-seine units and the artisanal inshore trammel-net/gillnet fishery. The deep driftnets compete now successfully with purse seines in deeper and offshore fishing grounds causing, however, new conflicts. Shore seines and longlines which existed until 1955 were abandoned as absorbing too much labour. Harpoon-gun fishing is prohibited in the lake.

The Market Situation

Demand for Sarotherodon, Tilapia and grey mullet is not being met by supply. Especially the Sarotherodon galileus is in high demand, perhaps because Sarotherodon aureus and grey mullet are grown also in ponds by fish breeders who produce larger quantities of these fish than those caught in the lake. The market for barbel, silver carp and carp is normal, whereas the market situation for the Kinnereth bleak is deteriorating. Only 10 percent of this small fish (12-14 cm) is sold fresh - only during the winter season; the rest is canned and, as far as taste is concerned, it cannot compete with the marine sardines.

Actual Problems of Fisheries Management at Lake Kinnereth

There is a steady and ever-growing pressure by the fishermen to authorize more fishing units, and a tendency of the existing units to increase quantity and area of nets (which needs no authorization) and to introduce echo-sounders and other modern gear, thus increasing fishing effort.

The rapidly decreasing prices of the Kinnereth bleak, caused by changes in customers' preferences, and the resulting effect on the feasibility of its canning by the industry endangers the purse-seine fishery, resulting in the concentration of fishing effort on valuable customer-preferred species.

The growth of the tourism industry and boating on the lake interferes with fishing. Natural shores are being reshaped and made inaccessible to fishermen. There is also a constant pressure for nature preservation which aims at reducing fishing activities.

Lake Kinnereth is the main water reservoir of the country; thus, water authorities seek to maintain good water quality in the lake. Scientists of the water authorities have expressed opinions and outlooks which are not in agreement with the management programme supported by the scientists of the Fisheries Department with respect to the stocking of the lake.

Fisheries Administration

The legal body responsible for fisheries and fish-breeding management and licensing is the Fisheries Department in the Ministry of Agriculture.

Another body involved with the lake is the Kinnereth Administration. It functions as an extension of the Water Commissioner's administration under the supervision of the Minister of Agriculture. The Kinnereth Administration has been appointed in order to deal with the environmental problems of the hydrological basin of Lake Kinnereth, the River Jordan, and the ecological aspects of the lake itself, first of all water quality. The Kinnereth Administration collaborates closely with the Laboratory for Kinnereth Research designed to deal with the lake's water quality. Relations between the Laboratory and the fisheries biologists of the Fisheries Department are loosely coordinated through scientific committees.

Other governmental bodies acting in the lake area are: the Ministry of Transportation which is responsible for navigation and safety; the Nature Reserves Authority which has interests in this area, and several other governmental agencies. There are two fishermen's organizations: the national Fishermen's Union and a local Tiberias Fishermen's Organization. Most of the Kinnereth fishermen are members of one or the other organization.

Fisheries Management Policy and the Means for its Implementation

The scientific basis for management is provided by the Fisheries Department through employment of several fisheries biologists and a senior scientific adviser. As mentioned above, another group of scientists deals with the ecological aspects of fisheries with respect to water quality.

For example, a research project has recently been launched to determine the fishing effort of purse seines with respect to different species and to reach conclusions for management of those species. Increase of mesh in the purse seines is now being contemplated as a result of a study of the bleak population. This should result in the improvement of the size composition of the catches.

The statistical basis and the intelligence for the management of the fisheries includes monitoring changes in fishing methods, unorganized marketing, etc. and the daily catches of all fishing units. Taking representative samples from fewer groups has been tested on an experimental basis and its introduction is under serious consideration.

Legislation of Kinnereth Fisheries

Licensing of professional fishing :

The existing legislation provides rules for licensing individual fishermen - and of fishing boats, including determination of the fishing methods assigned to each boat as well as other conditions. The main instrument of regulating fishing effort is therefore: licensing of boats, units and methods. Licensing of individual fishermen is less significant, as long as no misproportion between the number of vessels and number of individual licences occurs.

Licensing of boats and units - especially the large purse seine units - is a controversial and much discussed matter which sometimes comes up to the Ministry's Director-General or even to the Supreme Court of Justice. Therefore, already in the fifties, an advisory committee was appointed, semi-governmental/semi-public in its structure. The committee consists of fisheries experts, biologists, technologists, legal advisers and of representatives of local councils.

Criteria, considered by the advisory committee as well as by the Chief Fisheries Officer, for licensing boats and units are:

(a) Assessment of the stock of different fish populations

(b) Assessment of the economic situation of the existing branch and its units and, on the other hand, the situation of the applicants

(c) Professionality of the applicants, ability to conduct the proposed fishing using the desired fishing method

(d) Length of period in which the applicants have served as individual fishermen, employed in existing units, or length of period of previously existing small units, when uniting existing groups is proposed for the creation of new, larger units (purse-seine fishery).

(e) Integrity of applicants: absence of infringement or transgression of fishing rules and of criminal past.

Criteria for licensing individual fishermen:

(a) The number of existing licences and the proportion between individual licences and boat licences

(b) Integrity of applicant: absence of criminal record

(c) Family tradition of being fishermen (sons of fishermen's families are easily admitted)

(d) Being an inhabitant of communities located on the lake's shores

(e) Lack of other learned trade or profession or business

Functions of the Advisory Committee :

Formally, this Committee should play a consultative role. It holds annually a series of four to six licensing sessions. First, all the involved parties - new applicants and existing groups - are heard. Then the biological, economic, technical and social aspects are reviewed by the experts in each field and thoroughly discussed. Decisions, or more exactly recommendations, are taken by vote, in some of the cases unanimously, in others by majority. It is customary that valid recommendations must be reached by a large majority which is nearly always the case. These recommendations are accepted by the Director of the Fisheries Department and implemented. This rendering of uneasy or delicate problems of licensing to a large group of experts in different fields is an act of decentralization and delegation of authority. Its advantage lies in the fact that, in such a large group of experts, all relevant aspects are brought up and weighed - and there is great probability that a balanced decision is reached. Participation of interested parties, as members in the Committee, proved unworkable.

In 1981, the contents and procedures of the Advisory Committee's hearings and recommendations were examined thoroughly by the Supreme Court of Justice and found objective and efficient, and the Court supported the Fisheries Department's licensing procedures.

Licensing of sport fishing :

Massive sport fishing has not yet developed. Amateur fishermen are allowed to fish by line and hook from the shore without any licence.

Leisure boat owners tend to fish occasionally with nets, and non-inhabitants of the lake's shores tend to do the same from shore. As net-fishing by amateurs and visitors interferes strongly with the inshore fishing of professional fishermen, those activities are interdicted. Amateur licences are issued only for castnets which do not interfere significantly with trammel-net and gillnet fishing, but the number of amateurs using castnets is small.

A rule of thumb for licensing :

This general rule is to cautiously admit new units only when the general yield shows signs of increase, and the catch per effort shows at least no signs of decrease. Until now, the need never arose to discontinue the existing licences; instead, a slow but steady increase in the number of units has been achieved with the general catch rising from 300 t in the Fifties to 1,900-2,000 t in the Eighties, seemingly justifying the present practice of integrated management.

Licensing of fishing gear and methods :

Types of nets, minimum mesh size and minimum length of fish species are regulated to various degrees in accordance with the need to protect different species from being taken before having reached spawning age and size. As changes in this field occur, these measures have to be updated from time to time.

For example, gillnets must be of 80 mm mesh stretch to fit different species of barbel. Trammel nets, for fishing of Sarotherodon species, must have at least 70 mm - and in the spawning season even 90 mm - stretch mesh. Drift trammels for grey mullet have to be at least 80 mm stretch mesh; purse seines for Kinnereth bleak, 20-24 mm (additional rules related later). These mesh sizes are designed to release non-mature fish.

In the decade 1950-1960 the Fisheries Department had introduced a series of ordinances regulating - and limiting - the length and numbers of gillnets and trammel nets which were to be used by each fishing boat or unit. This measure was meant to prevent a too-rapid expansion of fishing effort. Gillnets and trammel nets were limited to 25 and 15 respectively for each boat and every net had to be stamped by an official seal. Nets found in the lake without this stamp could be confiscated.

The measure was applied for 3 to 4 years and then abandoned, not so much because of the technical problem of authorizing each net but mostly as the result of the observation that economical reasons prevented fishing units, sooner or later, from utilizing meaningfully larger quantities of nets than prescribed and that, if small infringements occurred, they did not justify the cost of the enforcement.

The most lucrative bleak fishery takes place in its main spawning area which is partly over shallow boulders and partly over deep and nearly stoneless lake bottom. The Fisheries Department introduced a special ordinance which divided this area into two sections separated physically by a line of buoys laid by the Department's fishery inspection vessel. The rocky area went to the artisanal fishermen and the smooth bottom area to the purse seiners. The measure proved to be very efficient and, after five years of implementation, this division of the fishing ground became a well-accepted fact and contributed to the elimination of yet another dispute among the Kinnerreth fishermen.

Another example of regulating a fishery relates to the winter fishing for Sarotherodon species at the hot springs off Tabgha. These springs attract large concentrations of this fish to a limited area. In order to avoid quarrels between fishermen the Fisheries Department introduced fishing "by turn". Only five boats can operate efficiently and simultaneously at the hot springs. The Fisheries Department created partnership of five boats and allocated a "fishing turn" for 24 hours to each partnership. The turns were decided by raffle - and legalized by appropriate publication. Thus existing licences have been furtherly limited by secondary regulations.

On the basis of our 45 years experience in licensing and regulating gear application, one may conclude that the Fisheries Department should intervene in limiting the number and size of nets of individual fishermen only in the case of an abnormal or alarming situation.

One problem encountered by the Advisory Committee on Licensing and the Fisheries Department is whether their decisions should be made solely on the ground of the biological situation of the fish stock, as prescribed by the Ordinance, or should they involve economic consideration. The Fisheries Department's attitude was that there exists a unity of those two aspects, and that the biological criteria when isolated from economic aspects lose their relevance and are not applicable. So far the legitimacy of this attitude is supported by legal advisers, but without appropriate legal amendment may be challenged by any time.

As many types of nets are used for multi-species fishing, the regulation of mesh sizes is sometimes difficult. Thus, for example, trammel nets are used for different Tilapia and even barbel species; Sarotherodon species are larger than less valuable Tilapia and Tristramella, hence the legal 80-90 mm mesh is suitable for the former but too large for the latter species. These, less desirable fishes occupy eco-niches which could be utilized by the more valuable species and from the point of view of management should be taken out in a maximum quantity. This dilemma is dealt with by allowing fishing with 75 mm mesh trammel net only during the main season of appearance of Tilapia, zilli and Tristramella, but this solution is far from being sufficient.

Another regulation requires installation of a large mesh "sieve" panel in purse seines for Kinnereth bleak. The whole body of these purse seines is made of 20-24 mm mesh. This is a rather small mesh size but helps to avoid gilling of the small fish. "Sieving" or "straining the catch" enables fish less than 12 cm of length to escape. Yet, the effectiveness of the "sieve" depends on the willingness of the purse-seine operators to do the sieving thoroughly, this regulation being enforced, if necessary, by confiscation of under-sized fish.

Enforcement :

The fisheries regulations are implemented by a small unit of fisheries inspectors.

Closed areas and seasons :

The lagoons at the northern shores of Lake Kinnereth, known as the plain of Batagha, have been declared closed to fishing during the spawning season (April-May) of Sarotherodon galileus, a fish assumed by some to graze efficiently on the seasonal blooms of the algae, Peridinium, which gives bad smell to the Lake's water. Since this opinion is not shared by others, this is a temporary measure

implemented on a trial basis. A special commission has been appointed by the Ministry of Agriculture to deal with this issue.

Some deliberations on the regulation of fishing effort in lakes :

Excessive fishing can no doubt cause considerable damage to fish populations in small lakes and therefore various limitations, some of them alternative and others complementary, are needed to protect the fish resources. Naturally, limitations and restrictions are disliked by most fishermen, hence the implementation of the regulation represents a social and political problem.

On the other hand, however, under-estimation of possible yields may be equally damaging. During the British Mandate in Palestine, in 1938/39, government fishery biologists, after an extensive study of the Kinnereth fisheries, established that the Lake had been over-fished: The annual catch in those years was 300-350 tons and the actual fishing effort less than nowadays. With the annual catch during the last decade ranging from 1,900 to 2,000 tons, it seems to be obvious that the conclusions drawn in 1939 were unjustified.

Stocking :

Stocking Lake Kinnereth with fry of several fish species is based on the following assumptions and facts:

(a) Sarotherodon galileus: There exists a limiting factor in the survival of small fry - high mortality occurs between the postlarval and the fingerling stages.

(b) Sarotherodon aureus: Natural spawning in the Lake seems to be limited. Until 1965 quantities of Sarotherodon aureus as a result of natural spawning were very small, in spite of the apparent abundance of food. Stocking trials gave immediate positive results.

(c) Hypophthalmichthys molitrix (silver carp): There is an ecological niche for these fish which graze to a large extent on nannoplankton, not utilized by others.

(d) Mugil species: Small fry caught in rivulets flowing into the Mediterranean, have been introduced in the Lake on an experimental basis in 1960-62. They grow fast and produce a good rate of return in the catch.

The Fisheries Department has therefore embarked on a continuous stocking of these fishes accompanied by statistical and biological monitoring.

Average numbers of fry stocked annually in Lake Kinnereth :

Sarotherodon galilaens	:	1.5 to 1.7 million - Size 4 to 5 grams
Sarotherodon aureus	:	1 to 2 million - Size 4 to 5 grams
Grey mullets	:	1 to 1.3 million - Size 0.1 to 0.5 grams
Silver carp	:	1.5 million - Size 1 gram

In order to safeguard a regular supply of fry, the Fisheries Department operates a hatchery comprising regular earthen ponds, for Sarotherodon spawning and raising - and a nursery equipped for induced spawning of silver carp. The hatchery facilities serve as a centre for the acclimatization and stocking of fry of Mugil species, which are supplied by contracted fishing groups from the shores of the Mediterranean.

Effect of stocking activities :

Statistical evaluation indicates that each million of stocked Sarotherodon galileus and S. aureus fry results in additional 80 to 90 tons of adult fish in the catch. Each million of stocked Mugil species fry results in about 120 tons of adult mullet, while each million of stocked silver carp results in some 100 tons of adult fish. This rate is still increasing, owing to fast growth. In recent years, about 600 tons, i.e. close to 30 percent of the annual catch, is the result of stocking. In economic terms, this corresponds to 60 percent of the revenue. The reason is that the non-stocked species such as Kinnereth bleak, Barbus and small Tilapia are relatively low-priced fish. The price ratio, e.g. between the stocked mullet and the bleak, is 0:1.

Stocking is, therefore, an integral element of management and, together with the other measures, enables the lake to maintain the high yield on a continuous basis. It permitted the modernization and intensification of the Kinnereth fisheries without causing any damage to the resource.

We must of course bear in mind that the carrying capacity of a lake is finite and therefore the state of the stock, yields and catch rates, as well as the steps taken by management have to be constantly and closely monitored.

Summary :

In retrospect, it can be said that fisheries management on Lake Kinnereth has dealt until now efficiently with:

(a) Limited entry: the method of reasonable licensing of fishermen (as described under "criteria") and in particular the consistent limitation of the number of fishing units - allowing their number to increase only when total catch was increasing and catch per effort was at least steady - has achieved its aim of avoiding depletion of the fish stock, and has supported the following positive developments:

- Annual catch increased from 300 tonnes to 2,000 tons owing to intensive stocking and the intensification of fishing methods such as, e.g. the introduction of multi-species nets and of efficient echo sounders in larger and more recently even small craft, the mechanization of purse-seine units and the introduction of labour-saving devices for packing and storage of large catches.
- The value and actual revenue of the catch have been raised immensely owing to the high prices for the stocked fishes.

(b) Marketing problems: the receding value of the Kinnereth bleak and the introduction of silver carp were dealt with in the following ways:

- The Laboratory for Fisheries Products in Haifa has developed new recipes and brands for the bleak, thus assisting the industry to improve its products.
- The Ministry has been coordinating efforts to safeguard throughput of bleak in the canneries.
- The Fishing Technology Unit in Haifa is advising the purse-seine fishermen in finding technical solutions aimed at increasing the minimum size of the captured bleak from 12 cm to 13 cm.

Acceptance of silver carp by the customers was facilitated by recipe propagation and product promotion.

(c) Economic assistance has been extended by granting loans to fishing groups and units, which tended to improve gear methods and vessels. A special joint fund was founded, with equal participation of the Fishermen's Union and the Ministry of Agriculture, in order to enable and facilitate major overhauls of fishing craft and installation of modern cold-storage facilities essential in the extremely hot climatic conditions prevailing at the lake. The Ministry has built and maintained three fishing harbours on the lake's shores in order to facilitate the anchorage and maintenance of fishing craft and the landing of catches under optimum conditions.

(d) Rules have been established in order to avoid conflicts between different fishing methods, and the Fisheries Department acts, if necessary, as an arbitrator.

(e) Ecological matters: the Fisheries Department keeps a watchful eye in order to coordinate the views and interests of the fishery sector with other public, economic or professional activities in the lake. Changes in environmental conditions and their possible influence on freshwater fish are continuously monitored through frequent inspection of the catch by the Laboratory of Fisheries Products. The Fisheries Department maintains contacts with all the previously-mentioned governmental agencies involved with environmental problems such as water quality, prevention of pollution, nature of reservation, navigation, etc.

Results :

The result of such active management, aware of and sensitive to the different approaches and special needs of the fishermen and fisheries has been the creation of a stable community of fishermen who are proud of their trade and conscious of their hard-earned rights.

In the fishermen's community, sons, grandsons and great-grandsons are clinging to the family tradition of being fishermen, in spite of the growing attraction and temptation of other easier and better-paid occupations in an industrializing society.

Licensing of fishermen and gear is only one component, even if an important one, in the complex system of fisheries management where, as we saw, biological, technical, economic and social problems have to be considered and dealt with.

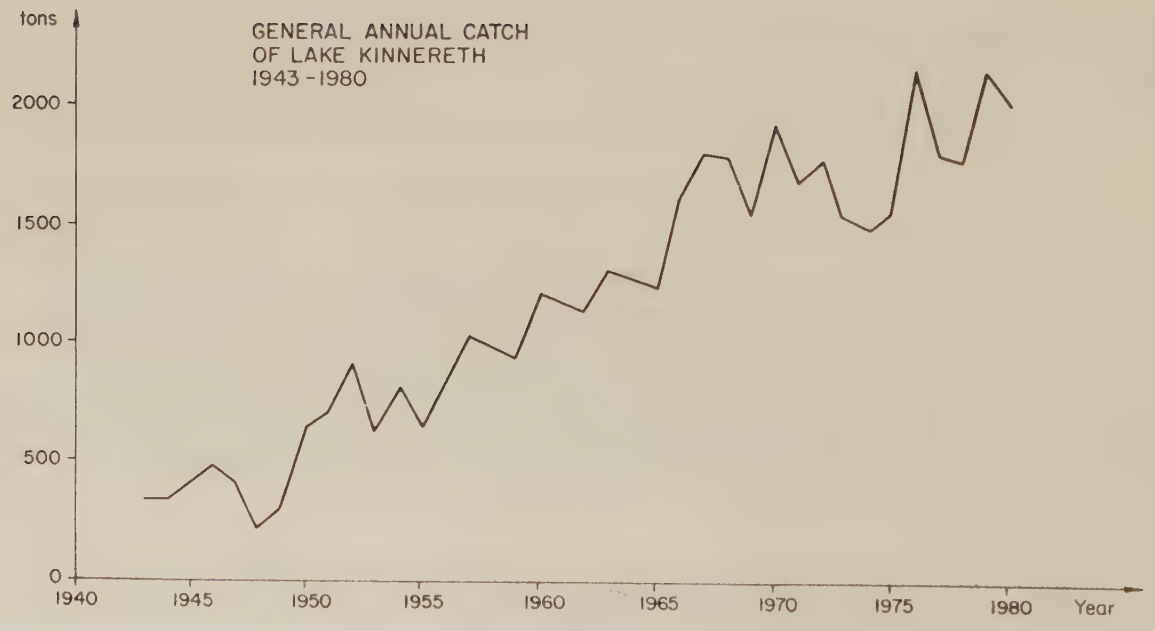


Figure 1

BIOLOGICAL BASIS FOR THE FISHERY REGULATION AND MANAGEMENT OF THE BARDAWIL LAGOON, MEDITERRANEAN COAST OF SINAI

by

A. Ben-Tuvia
Department of Zoology
The Hebrew University of Jerusalem
Jerusalem, Israel

Introduction

Fisheries biology investigations of the Bardawil Lagoon (Mediterranean coast of Sinai, Egypt) were carried out from December 1969 to April 1979, during the Israeli administration of this region. The present paper summarizes some of the information on the physical and biological aspects influencing fishery resources management for the Lagoon.

The main body of information on the Lagoon was given in internal reports in Hebrew by Ben-Tuvia and collaborators. A comprehensive summary and most of the bibliographic references pertinent to the Lagoon can be found in Ben-Tuvia (1979), Pisanty (1981) and Por and Ben-Tuvia (1981).

The Lagoon is a unique coastal water deeply influenced by human activities. The very existence of the Lagoon depends on man's interference and skill to provide favourable conditions for the growth of commercial fishes. Without the artificial openings in the sandy bar that separate the shallow depression from the Mediterranean Sea, the area in summer would be no more than a salty marsh.

Even with the two artificial openings the salinities were much higher than in the open Mediterranean Sea, fluctuating in the central section of the Lagoon between 45 and 65 percent, always considerably above the salinities of the parental sea. Higher salinities are detrimental to the fish stock. Therefore, it was essential to monitor salinities as a part of rational management in addition to monitoring fish population parameters (Gulland, 1974).

Geography and hydrographic features

The shallow, 0.5-1.5 m deep, hypersaline Bardawil Lagoon on the northern coast of Sinai covers an area of about 650 square km. It is separated from the open Mediterranean Sea by a long sand barrier in which two artificial openings, Boaz 1 and Boaz 2 are maintained (Figure 1). Because of the configuration of the terrain the natural opening, Zarnich, at the eastern corner of the Lagoon is not sufficient to enable proper flooding of the Bardawil depression.

Salinity was the most important abiotic factor influencing the ecological processes of the Lagoon and its fishery. It depended chiefly on the exchange of water through the two artificial openings (or inlets) in the bar and their periodical dredging.

Typical seasonal fluctuations of the salinities are shown in the example recorded for the year 1978 (Figure 2). The lowest values were recorded in the winter months and the highest during summer. Since there is no inflow of freshwater sources from the arid surroundings and the rate of evaporation is high, the salinities in general are much above the values of the eastern Mediterranean water masses. At the Boaz 1 and Boaz 2 openings the salinities are slightly over 40 percent but they increase with the distance from the openings. By determining the salinities at fixed stations across the Lagoon it was possible to evaluate the hydrographic conditions resulting from the state of the openings. Normal ecological conditions prevail when the salinity at the main water basin of the Lagoon (stations: Kalas, Rumia, Matiblis, Lashon 2) does not exceed 60 percent.

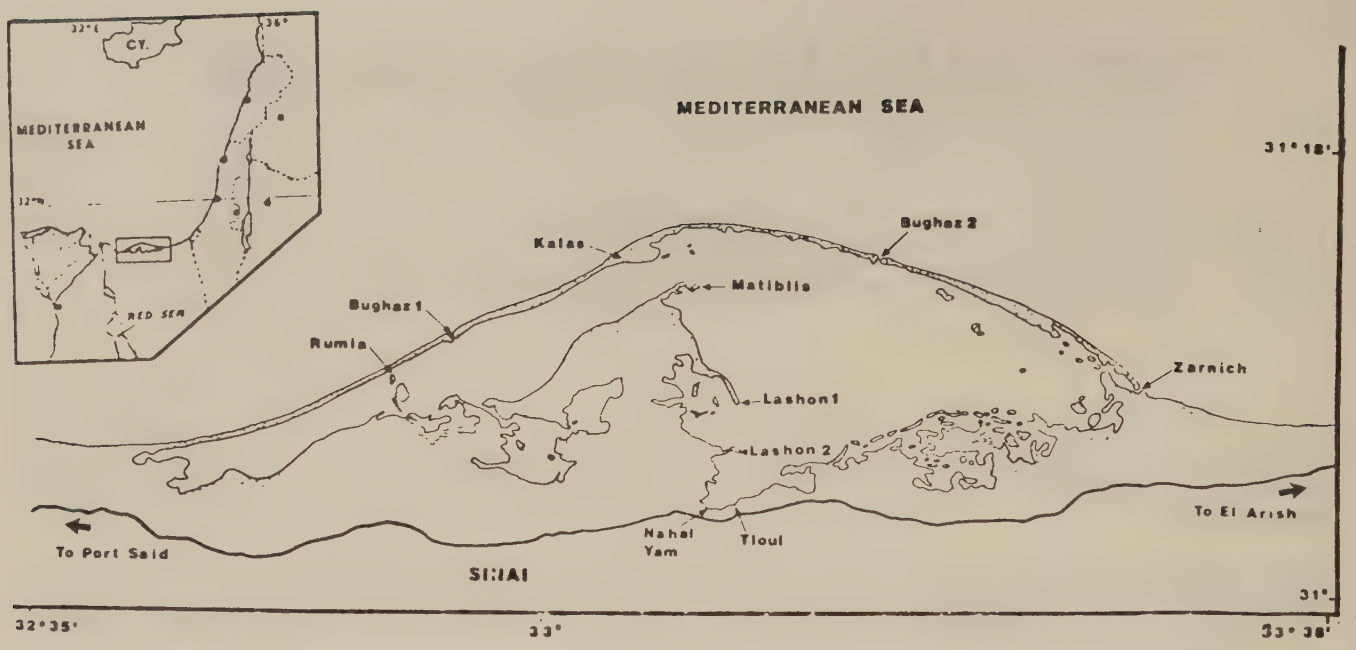


Figure 1 Map of the south-eastern Mediterranean and the Bardawil Lagoon showing the openings Boaz 1, Boaz 2, Zarnich and the main sampling stations

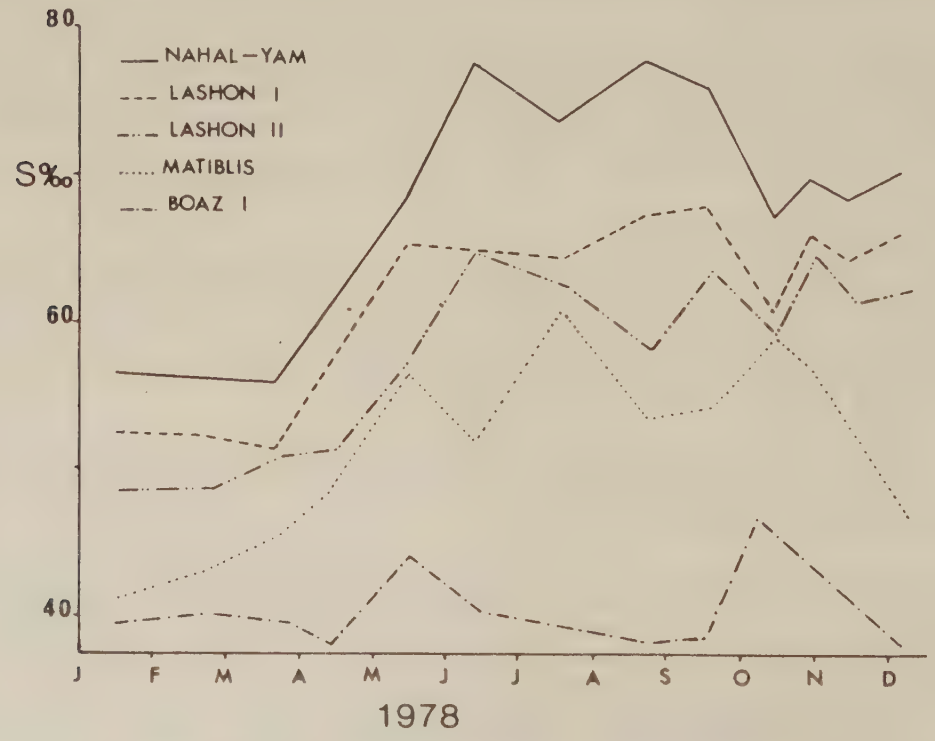


Figure 2 Monthly salinites at 5 stations recorded in 1978

The water tempertures of the Lagoon vary diurnally and seasonally. In Figure 3 averages of monthly surface water temperatures of Lashon 2, Matiblis, Haparsa and Rumia stations are summarized for the years 1973 and 1974. The lowest average temperature of 11.8°C was recorded for January and the highest, 30.6°C, for June. Meteorological data indicate that July and August have the highest average temperatures.

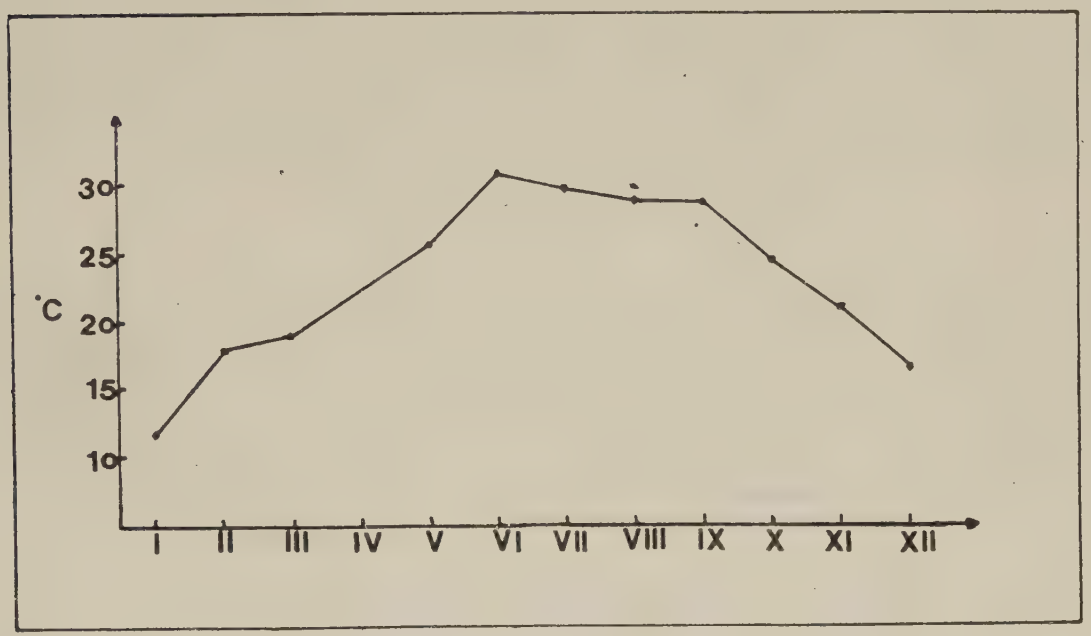


Figure 3 Average monthly surface temperatures recorded in 1973 and 1974 at Lashon 2, Matiblis and Rumia stations

Fishing methods

Three main fishing methods were employed in the Bardawil Lagoon in the years of the present investigations, 1969-1979:

(1) Purse-seine, known locally under the Italian name of 'cionciola'. The net is an adaptation of a purse-seine of the same name, commonly used along the coast of Israel for inshore-pelagic fish (Grofit, 1981). Its depth to length ratio is much less than in the Mediterranean purse-seine, about 1:9. This type of purse-seine was introduced to the Lagoon in 1970. Each fishing unit consisted of about 11 fishermen using a motorized boat with an auxiliary skiff. The fishing was carried out in day time and each haul lasted about 30-45 minutes.

(2) Trammel net, called locally 'dabba' or 'ambatan'. They were set over-night by two fishermen using a small boat, usually motorized.

(3) Beach-seine, called locally 'jaraf'. This is a bagless drag seine, 1-2 km long, pulled by ropes to the beach by about 25 fishermen.

Handling was employed in winter, mostly near the openings, to catch the migrating seabass, Dicentrarchus labrax. Its catch, which constituted a small fraction of the total, was registered under the three other fishing methods.

Although basically the same fishing methods remained in use during most of the period of study, the fishing power of each unit progressively increased due to technical improvements. Engines were installed in all fishing vessels, permitting quick search for fish concentrations and more efficient fishing techniques. Thus, for example, the number of hauls carried out by a purse-seine fishing unit in a day's work increased from about 8 to 15. One fishing unit in 1977 acquired a power-block. There was a general tendency to employ longer beach-seines and a larger number of trammel-nets by each unit. I estimate that the fishing efficiency of each fishing unit increased close to 100 percent during the years 1970-1978. Since there was a constant demand for fish during these years, the fishing effort of each operational unit was close to its maximum fishing capacity, within the framework of the restrictions imposed by the general management policy and the availability of fish.

Catches

The statistics must be divided into two periods. For the period 1968-1972, no precise catch-composition data are available. Only during the second period of study, 1973-1978, was it possible to obtain catch statistics for the main species by years (Table 1). The best indication of the state of the Lagoon is the catch of Sparus aurata. There was a dramatic decrease in this catch during the period of excessive salinities in 1970-1972. It increased considerably during 1974-1978 when the fishing regulations were fully applied. Thus in 1971 the catch amounted to 181 t and in 1977 to 1,946 t. The actual catch of the whole Lagoon in 1977-1978 was higher than shown by about 200 t since the present statistics (Table 1) do not include the landings in the western section of the Lagoon after the temporary changes in the demarcation line of the border between Egypt and Israel in 1977.

Some data on catch per unit of effort are given in Pisanty (1981). As pointed out in the chapter on fishing gear, a correcting factor should be applied to take into account the introduction of larger nets and improved fishing methods in recent years. The fact remains that, in spite of heavy fishing, the total catch increased. However, it is evident from the accumulated data that the average size of Sparus aurata declined in 1977-1978 as compared with preceding years.

Fish fauna

The Bardawil Lagoon was built for the practical purpose of utilizing the stock of fish for food. The fish fauna originates from the adjacent Mediterranean Sea, in the same way as the sea water of the Lagoon was formed by the evaporation of the Mediterranean Sea water (Krumgalz et al., 1980).

Because of the high salinities and pronounced fluctuations of temperature, only a small number of species, about 10 percent of the adjacent coastal fish fauna, is able to inhabit the Lagoon. However, most of them and in particular all commercial fish do not reproduce in the Lagoon.

The Lagoon itself is situated in an unusual geographical position, influenced by the proximity of the man-made Suez Canal and man-regulated Nile River, where the impoverished eastern Mediterranean fauna meet the Suez Canal immigrants from the Red Sea. The number of Red Sea immigrants, in proportion to the total number of species, is higher in Bardawil than in the eastern Mediterranean Sea. From the total of 36 Red Sea species, 17 have been collected in Bardawil Lagoon, including two species (Crenidens crenidens and Authistes puta) that have not as yet been found along the other sections of the Mediterranean coast. The Red Sea species in Bardawil constitute about one quarter of the total number of species collected. In the Mediterranean Sea they constitute only 11 percent of the total (Ben-Tuvia, in press).

The Bardawil fish fauna can be divided conveniently into three categories: (i) commercial species; (ii) common non-commercial species; (iii) rare species.

Table 1. Catch composition according to species and fishing gear in Bardawil Lagoon during the period 1968-1978

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
SPECIES											
Sparus aurata	694	1,006	345	181	520	825	931	1,322	1,226	1,946	1,625
Mugil cephalus						387	335	421	432	346	369
other Mugilids						248	314	76	143	102	57
Dicentrarchus spp.						239	168	216	225	169	173
Solea solea						38	67	58	55	59	48
Total	851*	1,387*	1,497*	728*	1,303*	1,737	1,815	2,093	2,081	2,622**	2,272**
NUMBER OF UNITS											
purse seine	-	-	-	-	-	20	22	22	27	31	30
trammel net	-	41	79	-	-	146	179	213	209	250	306
beach seine	66	63	28	-	-	42	37	21	15	10	3

* Includes *Sparus aurata* and unsorted fish

** Does not include an additional catch of about 200 t at the western section of the Lagoon

Among the commercial fishes three groups are important: Sparus aurata, six species of Migilidae and Dicentrarchus labrax. They constitute about 95 percent of the total. The other fishes of some commercial importance are Solea solea, Dicentrarchus punctatus, Argyrosomus regius, Umbrina cirrosa and Epinephelus aeneus. This is in striking contrast to the commercial catches of the open Mediterranean Sea, which usually contain a great number of species.

The gilthead seabream (Sparus aurata) of the family Sparidae ('denis' in local Arabic; 'sparus zahuv' in Hebrew) was the most important commercial fish in the Lagoon, constituting in recent years about 70 percent of the total landings. Its life history and fisheries biology in the Bardawil Lagoon have been investigated from December 1969 to April 1979 (Ben-Tuvia, 1979; Ben-Tuvia and Golani, 1979).

The rate of growth, based on otolith readings and corroborative evidence from length-frequency measurements, is given in Figure 4. The catch was composed chiefly of fish 180-300 mm, belonging to age groups 0-4. Under pressure of the increasing fishing effort, the average size of the seabream decreased in recent years.

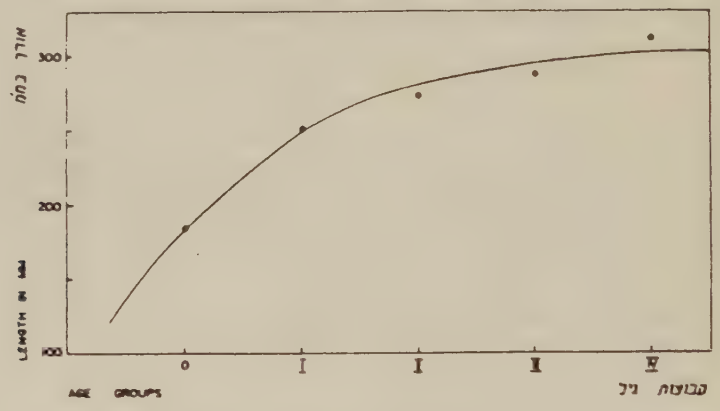


Figure 4 Growth rate of Sparus aurata

The following values for the parameters in the equation $W = KL^n$ (weight-length relationship) were estimated from the data: $K = 3.73 \cdot 10^{-5}$; $n = 2.81$ (Figure 5).

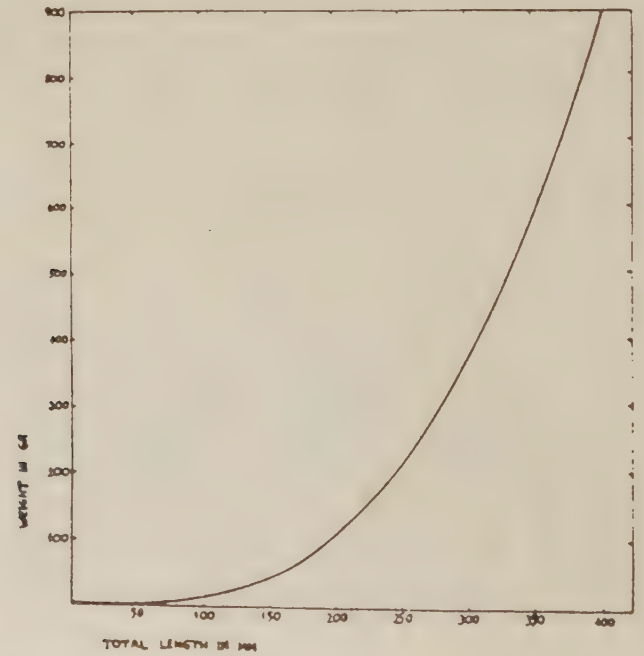


Figure 5 Length-weight relationship of Sparus aurata

The reproduction takes place in the Mediterranean Sea. All the adult fish, approaching the end of the second year and older, leave the Lagoon in November-December and evidently return to the Lagoon after spawning during the second half of February.

The silverside, Atherina boyeri, of the family Atherinidae, is a small fish which does not grow in Bardawil to a length of more than 55 mm. It is one of the most common fish in the Lagoon but as yet it has not been commercially exploited.

The life history of silverside was studied by Gon and Ben-Tuvia (in press) from samples collected with an experimental beach-seine in 1973 and 1974. Age determinations based on otolith reading and length-frequency distributions indicate that the Bardawil population is mostly composed of 0-age group. Older fish were few and their maximum age was estimated at 18 months. The fish feeds on zooplankton, mainly amphipods and copepods. Spawning takes place at least from March to September.

The biology of Dicentrarchus labrax was studied by Blostein (1976) and the biology of Mugil cephalus by Azoury (1979).

Maintenance of favourable physical conditions

As mentioned above, the two artificial openings - Boaz 1 and Boaz 2 - are essential for flooding the Bardawil depression and ensuring a vigorous exchange of the highly saline water of the Lagoon and the Mediterranean Sea. It was pointed out by Kapetsky (1981) that this type of management based on hydraulic engineering is a very important means for developing fisheries in both brackish and hypersaline lagoons.

Movements of sediments by currents and wave action along the coast (Nir, 1973; Neev and Ben-Avraham, 1977) causes silting of the two openings. It was estimated that the yearly accumulation of sand in these openings amounted to about 700 cubic metres (Pisanty, 1981). The state of silting could be clearly seen by aerial photography.

Restrictions in water exchange between the Lagoon and the sea resulted in an increase of salinities, having an adverse effect on the commercial fish stocks. This was illustrated by the situation of the Lagoon in the years 1970 and 1971. During the summer and autumn of 1970 the salinities in the central section of the Lagoon reached the value of 80 percent. The catch of Sparus aurata in 1971 was reduced to 180 t, less than one-fifth of the quantity caught in 1969 and less than one-tenth of the 1977-1978 catch.

Dredging of the openings was the most expensive part of the maintenance of the Lagoon, amounting to 80 percent of the total cost of the up-keep. Therefore it was important to keep the amount of dredging at a minimum, whilst maintaining favourable physical and biological conditions for a prosperous fishery. The experience of the present study indicates that dredging only every second year has no apparent ill-effect on the yield. In theory the amount of sand removed from the openings should be equal to the rate of sedimentation. From the accumulated experience it seems that dredging of 750,000 cubic metres once in two years was satisfactory but long-term observations are still needed. Other technical solutions for preventing the silting of the openings and finding more efficient ways of removing the accumulated sand were considered but not fully elaborated. In general terms it was agreed by experts that protective walls at the entrance to the openings should be helpful. One proposal is a funnel-like sand trap built at the opening, from which the accumulated sand would be pumped out continuously.

Mesh size and minimum legal size of fish

Studying the biology of commercial fishes of the Bardawil Lagoon was an important step in establishing guidelines for fishery-regulation measures. After a series of experiments, a minimum mesh size of 70 mm stretch was established in all nets. Such a mesh-eye allows the escapement of Sparus aurata below the minimum legal size of 180 mm total length, which corresponds roughly to an average length of the 0-age group at the end of first summer (Ben-Tuvia, 1979).

Additional regulations were adopted to reduce the fishing mortality on fishes belonging to 0-age group. It was found that beach seines catch a high proportion of small fish even with a 70 mm mesh size. The net is used in shallow waters, often in places where there is a high concentration of juvenile fish. The meshes are usually blocked by seaweeds and are less selective. Fishing with beach seines was often carried out with illegal mesh sizes in remote places where supervision was difficult. For all these reasons beach seines were progressively replaced by other fishing methods. In 1978 only three beach-seine units were left.

Limits on fishing power

Fishing in the Bardawil Lagoon was profitable according to the standards of the local population and served as an important source of employment. There was a steady market for the catch, for local consumption and for export. Therefore, there was a continuous pressure to allow more units to operate. Thus a policy was adopted of strict licence limitation for each fishing method.

The licence for the fisherman was valid for the whole year but, for the fishing unit, it has to be renewed each month. The number of fishing units was higher than the number of permits. Thus there was some rotation and queuing for the permit to fish during most of the months of the fishing season.

The replacement of beach seines by other fishing methods was based on an estimate that its efficiency equals 1.5 purse-seine and 8 trammel-net units.

It was also necessary to limit the size of trammel-nets employed by each unit to a maximum of 1,000 m and that of purse-seine to 400 m.

Closed seasons

Fishing was prohibited during the winter months, mostly from the beginning of November to the end of February. This closure was introduced for three reasons:

(1) Spawning migrations take place in winter. All adult fish of Sparus aurata approaching the end of their second year (age group 1) or older leave the Lagoon in November and December and spawn in the coastal waters of the Mediterranean Sea. It seems to be sound to allow the fish to migrate freely for reproduction.

(2) At the end of the spawning season, about mid-February the fish return to the Lagoon but are lean, losing apparently much weight during the spawning processes. Upon returning to the Lagoon the fish feed intensively and quickly regain their normal weight. Thus it seems advisable not to start the fishing in the Lagoon before March.

(3) Only one-year old fish, of 170-230 mm size, remain in the Lagoon during the winter months. For better exploitation of the stock it seems advisable to postpone their capture.

(4) The winter period coincides with the spawning migrations of another commercial fish, Dicentrarchus labrax.

Areas of interest for future investigations

The maintenance and further development of the Bardawil Lagoon fishery resources will require additional studies in the following fields of research:

(1) Silting processes of the openings and exchange of water masses between the Lagoon and the open sea;

(2) Monitoring salinities in various seasons and localities;

(3) Analysis of the impact of the fishery on the stock, taking into account the technological advantages and biological influence of various fishing gears;

(4) Better knowledge of the reproductive cycle of the main commercial fishes (gilthead bream, flathead grey mullet and sea-bass);

(5) Behaviour and survival of the gilthead bream in the open sea during the spawning season of the winter months;

(6) Tagging programme for the main commercial fishes in order to learn about their mortalities and migrations.

Better understanding of the population dynamics of commercial fishes is essential not only for the rational exploitation of the Bardawil Lagoon, but also for better management of other coastal lagoons in the eastern Mediterranean, that are predominantly inhabited by similar species. At the same time it will be important to develop fishing gear suitable for shallow lagoons and to analyse economic factors affecting the fishery.

Acknowledgements

I wish to thank the Civil Authorities of the North Sinai and the Israel Ministry of Agriculture for their financial support of the research project; the Department of Fisheries, the Israel Oceanographic and Limnological Research and the Hebrew University of Jerusalem for their assistance; Y. Maoz for his interest and encouragement; A. Baranes, Abigail Gilboa, Z. Herman, Dr. A. Tendler and A. Wilamovsky for research assistance; D. Golani for his research and technical assistance, especially helpful in preparation of the present paper; A. Niv for photography; and M. Ben-Yami for close cooperation in the early stages of planning and research work.

References

Azoury, R., 1979 Age, growth and steroids in the ovary of the gray millet, Mugil cephalus L., at various stages of development from the Bardawil Lagoon. M.Sc. Thesis, Hebrew University of Jerusalem, 59 p. (in Hebrew)

Ben-Tuvia, A., 1979 Studies of the population and fisheries of Sparus aurata in the Bardawil Lagoon, eastern Mediterranean. Invest.Pesq.,Barc.,43(1):43-67

———, The Mediterranean Sea. B. Biological aspects. In Estuaries and enclosed seas, edited by B.H. Ketchum. Amsterdam, Elsevier, pp.239-51

Ben-Tuvia, A. and D. Golani, 1979 Ten years of fisheries biology investigations of the Bardawil Lagoon. Fish.Fishbreeding Israel, 14(2):29-37 (in Hebrew with English abstr.)

Blostein, I., 1976 The biology of Dicentrarchus labrax in the Bardawil Lagoon. M.Sc. Thesis, Hebrew University of Jerusalem, 42 p. (in Hebrew)

Gon, O. and A. Ben-Tuvia, The biology of Boyer's sand smelt, Atherina boyeri Risso in the Bardawil Lagoon on the Mediterranean coast of Sinai. J.Fish Biol., (in press)

Grofit, E., 1981 The artisanal coastal fishery in the eastern Mediterranean. In Management of living resources in the Mediterranean coastal area. Stud.Rev.Gen.Fish.Counc.Mediterr., (58): 1-22

Gulland, J.A., 1974 Guidelines for fishery management. Rome, FAO. IOFC/DEV/74/36:84 p.

Kapetsky, J.M., Some considerations for the management of coastal lagoons and estuarine fisheries.
1981 FAO Fish.Tech.Pap., (218):47 p. (Issued also in French and Spanish)

Krumgalz, B.S., H. Hornung and O.H. Oren, The study of a natural hypersaline lagoon in a desert area
1980 (Bardawil Lagoon in northern Sinai). Estuar.Coast.Mar.Sci., (10):403-15

Neev, D. and Z. Ben-Avraham, The Levantine countries: the Israeli coastal region. In The Ocean
1977 basins and margins, edited by E.M. Nairn, W.H. Kanes and F.G. Stehli. New York, Plenum Publishing Corporation, pp.355-77

Nir, Y., Geological history of the recent and subrecent sedimnents of the Israel Mediterranean shelf
1973 and slope. Rep.Geol.Surv.,Israel, (MG/73/2):179 p.

Pisanty, S., The fishery and management of the hypersaline lagoon of Bardawil. In GFCM,
1981 Management of living resources in the Mediterranean coastal area. Stud.Rev.Fish.Counc. Mediterr., (58):35-73

Por, F.D. and A. Ben-Tuvia, The Bardawil Lagoon (Sirbonian Lagoon) of North Sinai - a summing up.
1981 Rapp.P.-V.Réun.CIESM, 27(4):101-7

QUOTAS BY FISHING GEAR FOR THE HERRING FISHERY OF THE BAY OF FUNDY

by

R.A. Crouter
Director-General
Department of Fisheries and Oceans
Atlantic Fisheries Service
Scotia-Fundy Region
Canada

THE TRADITIONAL FISHERIES FOR HERRING IN THE BAY OF FUNDY

The Bay of Fundy - South West Nova Scotia (NAFO 4X DIV) Herring Fishery is a highly complex mix of inshore (fixed) and mobile gear fisheries. The fishery began in 1870 as a weir operation providing fish for a newly developed sardine-canning industry. At the peak of this fishery, the number of weir sites exceeded 1,000 as compared with the 300 in existence today. In the mid-1930s, the first purse-seine vessels were introduced for the harvest of both juvenile and adult herring. This fleet of relatively small vessels reached a total of 50 during the war years but had dropped off to approximately 35 by the mid-1960s. Up to this point, the gill-net fishery was small and targeted on herring for bait and for minor quantities of food.

During the mid-1960s, a fishing revolution of sorts was to make its presence felt in the herring fishery of this area. A collapse of herring stocks had occurred on the west coast of Canada and, with a large potential in the Bay of Fundy for expansion of harvesting for fish-meal production, many purse-seining vessels were purchased and brought to the east coast. From this beginning, a large uncontrolled reduction industry developed, totally eclipsing the use of herring for all other purposes (based on catches by other gear types). Paralleling this development was the rise in activity of foreign fishing fleet, most notably vessels from the USSR, German Democratic Republic and Poland in the Georges Bank area. Without controls on any gear segment, over 500,000 tonnes of herring were landed from the Bay of Fundy and adjacent Gulf of Maine areas in 1968. This level of activity soon led to a collapse of the stocks on Georges Bank and a severe depression of the once stable Bay of Fundy stocks.

THE HERRING STOCKS

The herring stock which supports this fishery is actually a complex made up of two major migrating groups. One large stock group migrates between eastern Nova Scotia and the Bay of Fundy and is exploited in both areas, during the spring and summer periods respectively. This group represents the major fall-spawning component in the Bay of Fundy. In the fall period, after spawning, this stock migrates north eastward along the Nova Scotia coastline to over winter. The second stock component represents mainly juveniles migrating up from the coast of Maine, USA, to summer along the New Brunswick shoreline. While in the Bay of Fundy area, considerable intermixing occurs making any type of quota management by discrete stock difficult. At the present time, the biomass in the Bay of Fundy approximates 700,000-900,000 tonnes of fish, of which 500,000-600,000 tonnes are 4X stock. During the period prior to the event of foreign and domestic purse-seining effort, a third stock of fall spawners on Georges Bank also made a major contribution to the population abundance of the Bay of Fundy area; it is now apparent, however, that over-fishing has at least temporarily eliminated this stock as a contributor to the Bay of Fundy herring population.

THE PRINCIPAL HERRING FISHERIES

Weirs are fixed (stationary) gear representing a capital outlay of $30,000-50,000 per weir. The operating season extends from June to October, employing groups of two to three persons who may tend several weirs. Catches are variable, depending upon climatic and environmental factors, and, for this reason, weir ownership tends to be shared among several persons. Catches are composed mainly of juveniles and the bulk of the catch goes to supply the sardine-canning industry in Canada and in theUSA. In recent years, landings from weirs have approximated 30,000 tonnes, one-half of the total being canned in Canada for sardine and adult-herring products.

Gillnets may be of either fixed or drift types. The fixed gillnets are not a major factor in the fisheries, being operated mainly for bait supply on an as-needed basis. The drift-net fishery in contrast is a highly organized fishery of approximately 350 vessels. Effort is concentrated on spawning stock(s) and the catch performance, at eight to ten tonnes per vessel/day, is quite high, given the capacity of the vessels. This catch is utilized for food-herring products (pickled) and bait. Drift gillnetting for herring employs three persons per vessel and is only one of several fisheries in which these 45-ft vessels participate. While capital investment per vessel may extend from $50,000 to $100,000, only about $10,000 would be specific to herring. In recent years, the Bay of Fundy gillnet catch has averaged 5,000 tonnes annually.

Purse seines are operated from large seiners (over 65 ft in length) and from small seiners (under 65 ft). The large vessels, with replacements costs of up to $4,000,000, operate during an eight-month season within and outside the Bay of Fundy. Until 1979 these vessels fished in the Gulf of St. Lawrence, off the south coast of Newfoundland and around eastern Nova Scotia; but since that time they have been restricted to eastern Nova Scotia. They are licensed for the harvest of pelagic species only. The smaller seiners, with replacement costs of up to $600,000, are confined to the Bay of Fundy during a six-month period but 45 percent of them have licences for other fisheries (groundfish, squid, scallop). The total number of purse-seining craft in Atlantic Canada is now restricted to 66, 50 of which operate in the Bay of Fundy. These vessels crew six to eight persons, operate at night with resulting catches of 30 to 300 tonnes and land these catches within 12 hours of capture.

THE INTRODUCTION AND EVOLUTION OF QUOTAS IN THE BAY OF FUNDY HERRING FISHERY

While varying success has accompanied the introduction of several types of quotas for different purposes in this fishery, the Department remains committed to the use of a TAC calculated by scientific staff and more particularly to the so-called $F_{0.1}$ concept to re-enforce the conservational purpose of the TAC. The concept is defined as the level of fishing mortality at which an increase in yield from an additional unit of fishing effort is 10 percent of the increase resulting from addition of the same unit of effort on a lightly-exploited stock. Inherent in this approach is a margin-of-safety advantage as well as the disadvantages of failing to maximuze size of fish caught and to stabilize annual catch levels. A concerted effort is made by fishery managers to establish quota levels within the recommended TACs.

As has been described earlier, the herring fishery has been pursued in the Bay of Fundy area for over 100 years. It was not until the rapid expansion in fleet in the mid-1960s, however, that the need for quota control became apparent. The expansion of the purse-seine fleet to serve the emergent fish-meal industry destroyed the balance between effort and resource maintained during the previous century. For reduction purposes, highly specialized, efficient catching vessels directed an increasing level of effort on all herring stocks of this area, increasing harvest levels 5-10 fold. Without controls, declines in catches occurred swiftly and by 1971 landings by purse seines had dropped to 67,000 tonnes from 230,000 in 1968. It had become obvious that continued effort on such a scale would lead to disaster.

In 1972, ICNAF established quotas for the international herring fishery on Georges Bank (150,000 tonnes) and the Canadian Government introduced quotas, based on early biological calculations, for the Bay of Fundy area (60,000 tonnes). This was our first attempt at conservation through quota control and was put in place to restrict the catch of the mobile purse seine fleet. Because of relatively low capture rates, gillnetters and weirs on the Nova Scotia side of the Bay of Fundy were not included under this form of control until 1980. The weirs in New Brunswick exploit the US/N.B. stocks and have remained without control by quota. Between 1971 and 1975 the domestic catch of the purse seine vessels increased from 67,000 tonnes to 100,000 tonnes but values had fallen by 50 percent from previous years. Yielding only about $50,000 annually per vessel, or 50 percent of earning requirements. A crisis had developed. The next major change, consisting of the introduction of socio-economic considerations in quota management, was then introduced.

In response to a request from producers for financial support, the Department undertook a complete review of the east coast herring fishery. The recommendations emanating from this review included (a) reorganization of the industry, emphasizing improved bargaining power for fishermen, (b) concentration on food production to improve prices, (c) subsidization to avoid fleet reduction before or during the 1976 season and (d) restructuring of the processing and purse-seining components of the

industry for food production, with fishermen controlling raw-material harvesting and port marketing. Following these guidelines, a representative group of fishermen in the Bay of Fundy was formed and deficiency payments were made to the purse seiners (in September 1975), based on $12 per tonne landed in 1975 to a maximum of 1,500 tonnes per vessel.

The fishermen quickly realized that the solution to their economic problems rested with their ability to bargain effectively as a group, both to influence prices and to provide support for the much advertised objective of a rational industrial structure. Throughout 1976 the following actions were taken, initially involving the purse seine fleet only, as it was in the best position to respond to the government's initiative:

(1) Contracts were made with fishermen's representatives to assist in the development of a strategy and organization.

(2) The use of herring for meal production was prohibited, although specific "meal" quotas were later permitted to compensate for a lack of food-processing capacity.

(3) Compensation was paid to meal-processing companies for losses on capital investment in plants.

(4) A purse seiners' cooperative "Club" with authority to control harvesting and marketing, was formed, involving the introduction of a quasi-property right in the herring harvest for this entity. The control of catch and marketing lead to:

   a) Direct sales to (Polish) factory ships at prices previously unavailable to purse seine fishermen, with access for club members only.

   b) A delay in commencement of the fishery until agreement on price was reached with the processors.

   c) Sharing of catches to avoid dumping of fish at sea.

(5) Vessel quotas, including daily and weekly catch limits to match processing capacities were voluntarily imposed. This step represented a sub-allocation of property rights on a per-vessel basis.

(6) The company-owned fleet was transformed, through financial assistance from government, into one largely owned by fishermen.

(7) Assistance for vessel conversion, to permit landing of first quality herring, was also provided.

Based on a perceived commitment by fishermen, this programme achieved initially a measure of success. In 1976, landed values increased to $4.0 million over the $2.8 million recorded in 1975, despite a decrease in landings from 84,000 tonnes to 60,000 tonnes. Benefits spread throughout the fishing sector and Co-op members received $80 per tonne as compared with $51 per ton for a small number of non-member purse seiners. The cost to government was less than $2.0 million, with no "seed" monies being directed to the club, which accummulated capital through landing charges on members.

The success of the operation resulted in all Atlantic vessels joining the Co-op in 1977 but the spirit of mutual cooperation began to erode when 26 vessels left the organization in 1978 to form two separate associations. At the time of the break-away, it appeared the reasons were based on market availability (or lack of same) in the Fundy area, the desire for less direction in marketing and harvesting and for less internal monitoring. Support for the cooperative approach ceased when the economic influence of direct sales was removed.

The collapse of the fisherman-managed system and rejection of its apparent advantages after only two years induced imposition of more direct control by government. That control included continuation of the vessel-quota system. By 1980 both volumes of herring and prices for catches had declined substantially below the 1978-1979 peak period when prices exceeded $250 per ton. Prices had fallen to less than $100 and many vessels began forming ties to the processing sector in order to secure a market outlet. Mutual cooperation among skippers had collapsed and Departmental attempts to enforce vessel quotas proved to be largely unsuccessful.

The effect of drastically-reduced price levels brought home to vessel owners the realization that, with foreseeable stock projections, the fleet could not be viable. The domestic market, now demanding improved quality levels, left much of the fleet with a limited outlet for landings and the need for ever-increasing price support levels became paramount. The loss of negotiating power on the part of purse seine fishermen, coupled with problems in controlling individual vessel quotas, created a "nightmare condition" in the fishery. It was recognized at this time that the long-term solution to this situation involved fleet reduction. As an interim approach, a decision was made once again to take advantage of the apparent benefits that might be derived from a single, unified purse-seining organization.

DIRECT SALES

The Department approved extensive direct (over-the-side) sales to foreign buyers in 1981 and 1982, provided that the fishermen's groups combine under an umbrella organization once again to control such sales as well as sales in the domestic port market to exert control over individual fishing enterprises. This organization has performed well in terms of benefits to individual fishermen and the control of vessel quotas has been greatly improved. Indications at present suggest very strongly, however, that the glue holding this new association together is nothing more than the increased earnings made available by direct sales to foreign interests.

PROBLEMS IN THE APPLICATION OF QUOTAS

Our experience with the application of quotas by area, by gear type or by size of vessel (fleet class) within an area shows sufficient acceptance by the fishermen to be easily controllable. The situation is not the same, however, when we try to implement vessel quotas. The literature on the merits of transforming a common property resource into a private or quasi-private property resource through quotas fails to list some of the attendant problems. I hope that an outline of some of the problems we have encountered will be helpful to any manager facing the application of such quotas. Our experience convinces us that the application of vessel quotas is not easy but the approach employed was more the soft, persuasive one and less the confrontation route and this exacerbated the situation.

EQUITY CONSIDERATIONS

The application of quotas in the Bay of Fundy Herring Fishery affected the purse seiners mainly. The weirs in New Brunswick exploiting a different stock have not been subjected to any quota. The weirs in Nova Scotia along with the drift nets have been given an allowance, or quota in later years, at a level that did not reduce their historical catch and they were thus relatively unaffected, except that expansion was curtailed by effort control. It should be noted that we did not study the relative economic merits of the prevailing allocation among competing gears or of alterations thereto.

Equity considerations, therefore, apply principally to the purse-seiner fleet, comprising large and small vessels. The initial application of a seiner-fleet quota in 1972 restricted seiner output because this fleet was seen as the principal contributor to the decrease in resource availability. Such considerations became of major importance only with application of individual seiner quotas directed to:

a) The survival of the seiner fleet in the face of several reduced resources and a drastic fall in the price of herring.

b) The promotion of fishermen's associations for more effective participation in fishing management.

c) The protection of the less competitive small seiners in the Bay of Fundy.

It must be stressed that reduced resource availability forced us to impose vessel quotas at a level that made their introduction more difficult. We were stuck at that time with a fleet of vessels that, in terms of number, size and type, was not well suited to the fishery that was developing. The vessel quotas did not address the longer-term problem of appropriate fleet size.

The method of allocating these quotas had to have some acceptance by the seiners and, since the majority of them operated smaller, less competitive units, some level of protection had to be afforded to these latter. The several allocation systems recognized this non-competitive situation and tried to compensate by providing a relatively favourable allocation to the smaller vessels. This was accomplished by uniform vessel shares in the Bay of Fundy, set at a level that provided superior returns to the smaller in comparison with the larger vessels.

The measure represented special support for certain fleet elements at the expense of "high Liners", which experienced drastic reductions from their historic catch levels. This effect may be considered as an equalization of earnings in a fishery upon which approximately 50 percent of the fleet were totally dependent. The remainder of the fleet accepted the approach because the Bay of Fundy fishery was only one of the seasonal fisheries prosecuted and the subsequent dollar returns from a food fishery compensated for the loss in tonnage. For the local fleet, both catch levels and markets became secure, affording this fleet component the potentially improved earnings.

Differences in size of the Fundy seiners influence the mobility of their operations. Generally vessels less than 65 ft in length are confined operationally to the Bay itself while the larger craft have operated in eastern Nova Scotia, in Newfoundland and in the Gulf of St. Lawrence, depending upon the availability of the resource. In the first decade of seiner operations the average catch per vessel within the Bay of Fundy was only one half of that outside the Bay. In the past six or seven years, resource availability has shifted so that the amount available per seiner within the Bay of Fundy now exceeds by 25 percent the amount available outside the Bay. The change in relative resource availability has brought about a change in the method of allocating access.

Differences in dependence of the seiner fleet upon the herring resources of the Bay of Fundy is also reflected in the number of other fisheries to which the seiners have access. Seiners over 65 ft in length generally are denied entry to groundfishing and scalloping but may enter fisheries for other pelagic species such as tuna, capelin and mackerel. In 1981, 77 percent of this fleet had no licence other than herring. The seiners under 65 ft by comparison have access to a greater number of fisheries and have been somewhat less dependent upon herring as a source of revenue. In 1981, 37 percent of this group had no licences other than herring.

In recent years a closer relationship has developed between some seiners and the companies to which they sell their herring landings. Some companies have invested in and, consequently, influence or control the operations of several seiners. The extent of this control or ownership affects the interplay of forces that establish prices between the companies and vessel operators. Individual vessel quotas bestow or restore some bargaining power to the seining enterprises, both individually and collectively.

What have vessel quotas accomplished during the years 1976-1982?

1) They made the impact of fleet rationalization less severe but retarded the development of an efficient fleet so that we are left with a fleet segment consisting of small, inefficient vessels and another segment of over-capitalized fishing craft.

2. They favoured the survival of fishermen's associations and provided an opportunity for greater involvement by fishermen in day-to-day management decisions but they could not preserve the initial unity among the fishermen.

3. They promoted individual ownership of vessels among fishermen but they did not retard ownership and control by fish buyers (herring processors).

ADMINISTRATIVE CONSIDERATIONS

In order to permit fishermen to participate to a greater extent in the management of their own fishery, an advisory process has been set up. This includes:

1. An advisory committee comprising representatives of all gear types that exploit the Bay of Fundy/Eastern Nova Scotia herring stocks (including entrepreneurs and crew members) and of the processors who depend upon these landings.

2. An advisory committee consisting of representatives of associations of purse-seiner owner/operators who operate within Atlantic Canada. In addition, associations of processors and associations of purse-seiner crew members meet with departmental representatives to promote their individual interests.

In order to obtain useful input from these various groups, we have found that a major educational process has been necessary. The implications of area quotas, vessel quotas, association quotas, the findings of biological and economic analyses, and the understanding and acceptance of the need for conservation have to be explained repetitively. We have found that the encouragement of fishermen to share in and even to exercise some control over the management of their fishery is and will continue to be a long and ardous undertaking. For example, over 20 meetings with the purse-seine committee alone were needed in 1982.

We have recently experienced a deterioration in the quality of the information provided by fishermen about their operation - volume of landings, area of capture, etc., which in turn reduces the ability of the Department to monitor quotas. This deterioration in information quality has forced the Department to make greater use of estimating procedures and of duplicate information systems to ensure reasonable effectiveness in enforcement operations.

ENFORCEMENT CONSIDERATIONS

The only major enforcement problems we have faced in the Bay of Fundy fishery have been related to individual vessel quotas in the purse-seine fleet. Fleet, gear or area quotas have generally been enforceable. Our experience with vessel quotas has been that each and every fisherman will attempt to "cheat" on his quota and processors will promote that attempt through collusion in falsifying records. Integrity can be incorporated in the system only by co-management of government and producers' association or by the imposition of extremely harsh penalties. This problem in the Bay of Fundy and eastern Nova Scotia areas is exacerbated because of the large number of off-loading docks and by the absence of legislation requiring the weighing of fish at time of purchase.

FUTURE CONSIDERATIONS

I would now like to present some future options.

Setting the level of TAC

This Department has adopted a general policy of following an $F_{0.1}$ approach in determining TACs. This does not appear to be the ideal approach for herring fisheries because it does not permit maximization of size of fish nor does it permit stabilization of the annual harvest. Our scientific staff are now addressing those problems.

Vessel Quotas

Vessel quotas have not been a useful tool overall in the management of the Bay of Fundy purse-seine fishery. We are currently developing a substitute approach which would see the introduction of separate large and small-boat fleet quotas with a free fishery within those quotas. This would protect the small-boat fleet but it would at the same time re-introduce competitive fishing.

Property Rights

We will continue to encourage government deregulation through implementation of property or quasi-property rights. This could come about as a second step to the large-boat/small-boat quota approach or from consolidation of all purse-seine vessels into a single category. Ideally the fishery would be best managed by industry as a whole through a property-right process, with the Department setting TACs and providing some level of enforcement.

MANAGEMENT OF THE ATLANTIC GROUNDFISH FISHERY
Under the US Magnuson Fishery Conservation and Management Act, 1977-1982

by

Frank Grice and Peter Colosi
National Marine Fisheries Service - Northeast Region
Gloucester, Massachusetts, USA

Atlantic Groundfish Management

The Atlantic Groundfish Management Plan was the first fishery management plan developed and implemented under the United States Fishery Conservation and Management Act of 1976 (FCMA), the US 200-mile fisheries legislation. The plan was hurriedly developed for the New England Fishery Management Council, by modifying the existing quota management system then in place under the International Commission for Northwest Atlantic Fisheries (ICNAF). At the time, it was important that no hiatus in regulations governing both domestic and foreign fishermen be allowed to occur following US withdrawal from ICNAF.

In March of 1977, when the plan went into effect, the stocks of groundfish (defined in the plan as cod, haddock and yellowtail flounder) were still severely depressed, having been drastically over-fished in the 1960s and early 1970s by the huge distant-water fleets which had concentrated on the Northwest Atlantic.

Since the 1930s, these three species had produced annual landings by US fishermen of approximately 140,000 tonnes, without any indications of over-fishing. In 1965 and 1966, total landings of haddock alone averaged 135,000 tonnes in comparison with the previous long-term average US catch of 52,000 tonnes. By 1974, the annual catch of haddock had declined to only about 5,000 tonnes.

Cod stocks, following the years of heavy foreign fishing in the 1960s, had rebuilt more rapidly than haddock and, by 1977, catches had been restored to about 2/3 of the former long-term average (about 45,000 tonnes). Yellowtail flounder stocks, although subject to wide fluctuations in the past even before heavy foreign fishing, appeared to have a long-term potential of about 40,000 tonnes annually, although in 1977 landings were only about 1/3 of that average.

The US groundfish fishery traditionally has been primarily an otter-trawl fishery, utilizing small to medium sized vessels up to a maximum size of about 150 tonnes. The smallest of these vessels make one-day trips and the others normally fish three to eight-day trips. Smaller amounts of groundfish are also taken commercially by gillnets and line trawls and an active recreational fishery exists for cod and haddock. A total of 641 commercial vessels were involved in the fishery in 1976 and this number rapidly increased to almost 1,000 vessels by 1979. Fishing for groundfish normally takes place both in inshore, or coastal waters, and offshore out to 200 miles.

Under ICNAF jurisdiction, increasingly restrictive quotas, by-catch limitations, mesh size restrictions and closed spawning areas were beginning to provide effective resource protection. When these restrictions, especially the relatively low individual species quotas, were incorporated into the new management regime, the US industry was shocked into the realization that simply eliminating foreign fishing had not solved all their problems. Approximately four months after the new plan was implemented, the first closure for domestic fishermen was imposed on the cod fishery in the Gulf of Maine when the annual quota for that area (5,000 tonnes) was attained (see Table 1). Subsequently, before the summer of 1977 was over, the entire cod fishery was closed and it was obvious that long-term closure of the whole groundfish fishery was imminent. Such an overall closure came in December, even though the quotas had been increased in November by emergency action in an attempt to avoid the severe economic impact of a total closure.

Table 1

Major actions under the Groundfish Management Plan
for the period 1977 to 1982

Effective Date	Action
1977	
15 March	Groundfish Management Plan implemented: contains annual quotas, mesh size, minimum fish size, closed spawning areas, mandatory reporting. Quotas: Cod - Gulf of Maine, 5,000 tonnes; Georges Bank, 200,000 tonnes; Haddock, 6,200 tonnes; Yellowtail - 69°E 10,000 tonnes, 69°W 4,000 tonnes.
8 July	Gulf of Maine cod fishery closed - incidental catch only allowed.
22 August	Georges Bank cod fishery closed - incidental catch only allowed.
3 November	Quotas increased: Cod - Gulf of Maine 12,000 tonnes, and Georges Bank 21,650 tonnes; Haddock, 10,500 tonnes; Yellowtail founder - 69°W 6,000 tonnes. Daily trip limits imposed on vessels taking cod, haddock and yellowtail flounder in non-directed fishing activity.
23 December	All cod, haddock and yellowtail fisheries closed for remainder of calendar year.
1978	
1 January	Annual quotas for 1978 fishing year: Cod - Gulf of Maine, 6,000 tonnes; Georges Bank, 22,000 tonnes; Haddock, 8,000 tonnes; Yellowtail flounder - 69°W 3,700 tonnes, 69°E 4,400 tonnes.
1 March	Gulf of Maine cod fishery closed - incidental catch only allowed.
19 March	Georges Bank cod fishery closed - incidental catch only allowed. Entire haddock fishery closed.
30 April	Major Plan amendement: cod fishery re-opened but changed from directed fishery to incidental fishery by weekly trip limits.
7 May	Cod, haddock and yellowtail flounder, weekly trip limits based on vessel classes.
2 June	Cod and haddock weekly trip limit reductions.
1 July	Final regulations of plan amendment initiated on 30 April 1978.
23 July	Cod, haddock and yellowtail flounder, vessel class allocation system fully implemented.
5 August	Gulf of Maine cod fishery closed for 61-125 GRT and fixed gear vessel classes.
16 August	Gulf of Maine cod fishery closed for all vessel classes.
17 September	Georges Bank cod fishery closed for 61-125 GRT vessel class. Yellowtail founder trip limits reduced.

Table 1
(continued)

Effective Date	Action
1978	
1 October	New fishing year dates established (1 October to 30 September) with new quotas and vessel class trip limits.
13 November 27 November 17 December	Thirteen cod, haddock and yellowtail flounder fishery closures of various vessel classes during first quarter of fishing year.
1979	
4 February	Five cod and haddock fishery closures for vessel classes in second quarter.
13 March	Yellowtail flounder trip limits reduced.
22 April	Gulf of Maine cod fishery closed for 61-125 GRT vessel class.
28 April	Yellowtail flounder fishery closed for all vessel classes west of 69°.
22 July	Gulf of Maine cod fishery closed for all vessel classes. Gulf of Maine, haddock fishery closed for 61-125 GRT and 125+ GRT vessel classes.
1 October	All vessel class quotas increased to reflect stock size increases.
1980	
6 April	Yellowtail flounder incidental catch limits increased.
13 April	Yellowtail flounder fishery west of 69° closed to directed fishery.
30 September	Gulf of Maine and Georges Bank cod fishery weekly trip limits reduced.
1 October	New vessel class quotas established for new fishing year.
2 October	Plan amendment final, new quotas in place.
21 December	Yellowtail flounder fishery trip limits for west of 60° increased.
1981	
5 April	Gulf of Maine and Georges Bank cod fishery trip limits reduced.
29 September	Interim Groundfish Plan approved by Council.
1982	
30 March	Interim Groundfish Plan implemented by emergency regulations.

In the next few years, many similar emergency increases in the quotas were advocated by the fishing industry and the New England Fishery Management Council and either implemented or rejected by the National Marine Fisheries Service. These changes in quotas and closures, coupled with the adoption of many new regulations designed to provide for a more equitable allocation of the harvest, based on boat size and area fished, added up to a complicated maze of rapidly changing regulations which thoroughly disillusioned even the most conscientious fishermen. In 1978 a total of 16 regulatory changes in the groundfish management regime occurred.

In 1979 there was widespread industry dissatisfaction with the existing vessel class and trip limits, which had been established to spread the annual quota throughout the fishing year. Many fishing vessels were in violation of the existing regulations on every trip they made. Other vessel operators utilized a loophole created by the lack of complementary regulations in some state waters (0-3 miles) to claim that their catches were from these inshore areas rather than from the area under federal jurisdiction (3-200 miles).

This illegal activity was encouraged by a lack of timely prosecution of those fishermen who were apprehended by the enforcement agencies. Some chronic violators openly defied the fishing regulations, because the legal steps required to penalize infractions were so cumbersome and time-consuming that it appeared that no penalties would ever be actually imposed. Also, because of an extensive appeal system incorporated into the law, some fishermen were able to avoid the payment of any fines for over five years.

One of the major reasons for the lack of support from industry for the quotas was the rapid recruitment and consequent abundance of all three species of groundfish. Much better than average year classes of cod and haddock were spawned in 1975 and, by 1977, these young fish were beginning to recruit to the fishery in such large numbers that catch rates increased markedly, leading to quota excesses and enormous discards of young fish too small to be marketed successfully.

Many fishermen, seeing the abundance of these young fish, felt that the restrictive quotas were no longer needed and advocated a wide-open fishery. However, assessment scientists were concerned that, since these few large year classes would have to provide for the re-building of the stocks until other successful year classes were spawned, it was important that fishing mortality of the young fish not be excessive.

Although net mesh size restrictions were a part of the groundfish management system, these regulations were practically unenforceable. Despite repeated attempts to get industry to support changes which would outlaw the possession of small mesh cod-ends on groundfish boats, this was never accomplished, since fishermen argued that it was necessary to use small mesh on the same trip for other species such as redfish and hakes, in order to make a profit. Through the use of small mesh cod-ends and eventually even with legal-sized cod-ends of 130 mm, tremendous numbers of immature haddock, cod and yellowtail were discarded at sea or brought in to be sold at a lower price than normally paid.

In spite of the unpopular quota and trip limitations, the groundfish fleet expanded rapidly in the late 1970s, with the addition of many new vessels. Most of these new boats were medium to large stern-trawlers (over 100 tonnes) and replaced smaller, less capable old boats, thus greatly increasing the overall fishing power of the fleet.

The New England Fishery Management Council which, by law, was charged with the responsibility of developing and monitoring the Fishery Management Plan for groundfish, was reluctant to recommend any action which directly addressed the issue of limiting fishing effort. Thus no attempt to impose any effort limitations on the rapidly expanding fleet occurred, even though it was obvious that the quotas were being split between more boats, many of which had much greater fishing power than the older vessels which formerly made up the fleet. As new vessels came into the fleet, the vessel class quota system became more and more unbalanced, since most of the new additions to the fleet were in the large vessel class, yet no change was made in the percentage of the total quota assigned to that class. By 1979 the large vessels were almost always facing closures, whereas the medium and small-boat classes were not as severely limited.

Despite this imbalance, the Council was reluctant to make adjustments in the four vessel class quotas, since they had become so disillusioned with the quota management system that they felt it was better to replace the plan completely rather than attempt any fine tuning. Eventually, the quota system was replaced with a much simpler, less restrictive plan, incorporating only spawning area seasonal closures, mesh size restrictions by area and minimum fish-size limits. This system, called the Interim Groundfish Plan, was designed to provide a temporary change from the quota system until a more comprehensive and, hopefully, acceptable plan could be developed by the Council. It was recognized that this Interim Groundfish Plan might be sufficient by itself to protect the groundfish stocks from over-fishing.

Of all the various management regulations which were implemented under the original groundfish plan, only one received general acceptance by the fishermen. This was the closure to fishing of areas designated as major haddock spawning grounds for those months when most of the spawning activity occurred. Two major offshore areas where known concentrations occurred were closed to bottom fishing for the months of March, April and May of each year. The rationale behind this measure was that spawning success would be enhanced by providing protection for the mature fish and their spawn in these areas of concentration.

In summary, the Atlantic Groundfish Plan after its implementation in 1977 quickly became highly unpopular with both the groundfish industry and the Council which was responsible for its development. Within the first year, because of industry pressure, increases in the quotas were made. This set a precedent for many later emergency adjustments and changes which eventually became so numerous as to be almost incomprehensible.

The fishing industry perceived the quota restrictions as being unnecessarily restrictive, because of the apparent rebuilding of the stocks. Yet the inflexibility inherent in the administration of the law resulted in long delays between new stock assessments and corresponding adjustments in the quotas. Also, the lack of timely prosecution and imposition of penalties for violations of the quotas and other regulations led to repeated violations by some boats and the feeling by many other fishermen that anyone could get away with violating whatever parts of the system they disagreed with.

These attitudes eroded any real support for the plan either by the industry or the New England Fishery Management Council itself. It was perceived that the plan was not working, notwithstanding that in only four years the stocks were well on their way to recovery to former levels, the fishing fleet had been rebuilt and the value of landings had more than doubled.

The primary lesson to be learned from past management of the groundfish fishery is that any system must be capable of being understood by those being regulated; must be consistently applied to all involved with some assurance of equity and must be responsive to resource and industry changes.

ANCHOVY MANAGEMENT BY QUOTA

by

R. McInnis
National Marine Fisheries Service
USA

Introduction

This paper describes the experience of the United States National Marine Fisheries Service in managing the US fisheries for northern anchovy (Engraulis mordax), the purpose being to provide background for discussion.

Since 1978, the US fisheries for anchovy have been managed under Federal regulations based on the Northern Anchovy Fishery Management Plan (FMP). In that FMP, the Pacific Fishery Management Council (PFMC) recommended objectives for managing the fisheries and a combination of harvest quotas, seasons and area closures to achieve those objectives. This paper will describe the approach taken to manage a resource with a widely fluctuating biomass, in which management by an average maximum sustainable yield is not adequate. The resource is an extremely important prey species for commercial and recreational species and is essential to a small purse-seine fishery and to a large recreational fishery as bait. The following brief descriptions of the stock and the fisheries were excerpted from the FMP (PFMC, 1978).

Stock

The northern anchovy is a common pelagic schooling fish of the west coast of North America, that ranges from the Queen Charlotte Islands (Miller and Lea, 1972) to Magdalena Bay, Baja California (Ahlstrom, 1968; Mais, 1974). The population has been divided into northern, central and southern sub-populations, based on variations in meristics and electrophoretic separation of the blood serum protein, transferring (Vrooman et al., 1981), as shown in Figure 1.

The boundary between the northern and central sub-populations is not well defined. Sampling in the boundary area between the two sub-populations has been nearshore and too sparse to define the division. The boundary probably fluctuates seasonally and annually in the area just north of San Francisco, i.e. approximately 38-N.

The central sub-population, the most abundant of three sub-populations (Vrooman and Smith, 1971), extends from 38-N to approximately 30-N at Punta Baja, Baja California, in the south. The bulk of the biomass in the central sub-population is consistently located in the southern California Bight, bounded by Point Descanso, Mexico, in the south, and a series of banks and islands extending in a northwest-southwest direction from San Miguel Island to Sixty-Mile Bank (Mais, 1974). The San Pedro and Port Hueneme anchovy reduction fisheries take place in the channel area of the southern California Bight bounded in the north and west by the city of Santa Barbara and Santa Cruz Island and to the south and east by Santa Catalina Island and Dana Point, an area approximately 90 miles long and 22 miles wide. Based on egg and larvae surveys and recent acoustic surveys conducted by the California Department of Fish and Game, approximately 1/6 of the central sub-population inhabits the channel on average.

The division between the central and southern sub-populations is relatively well defined. The southern sub-population extends south from approximately 30-N, Punta Baja, to approximately 24-N, Magdalena Bay (Ahlstrom, 1968; Mais, 1974). This sub-population is harvested to some extent by the Mexican anchovy fishery.

In conclusion, the central sub-population ranges from approximately 38-N to 30-N and extends offshore approximately 200 miles. The central sub-population is distinct from both the northern and southern sub-populations and is the target of both US and Mexican anchovy fisheries. Regulations discussed in this paper are applied only to the central sub-population and only to the US fishery on that sub-population.

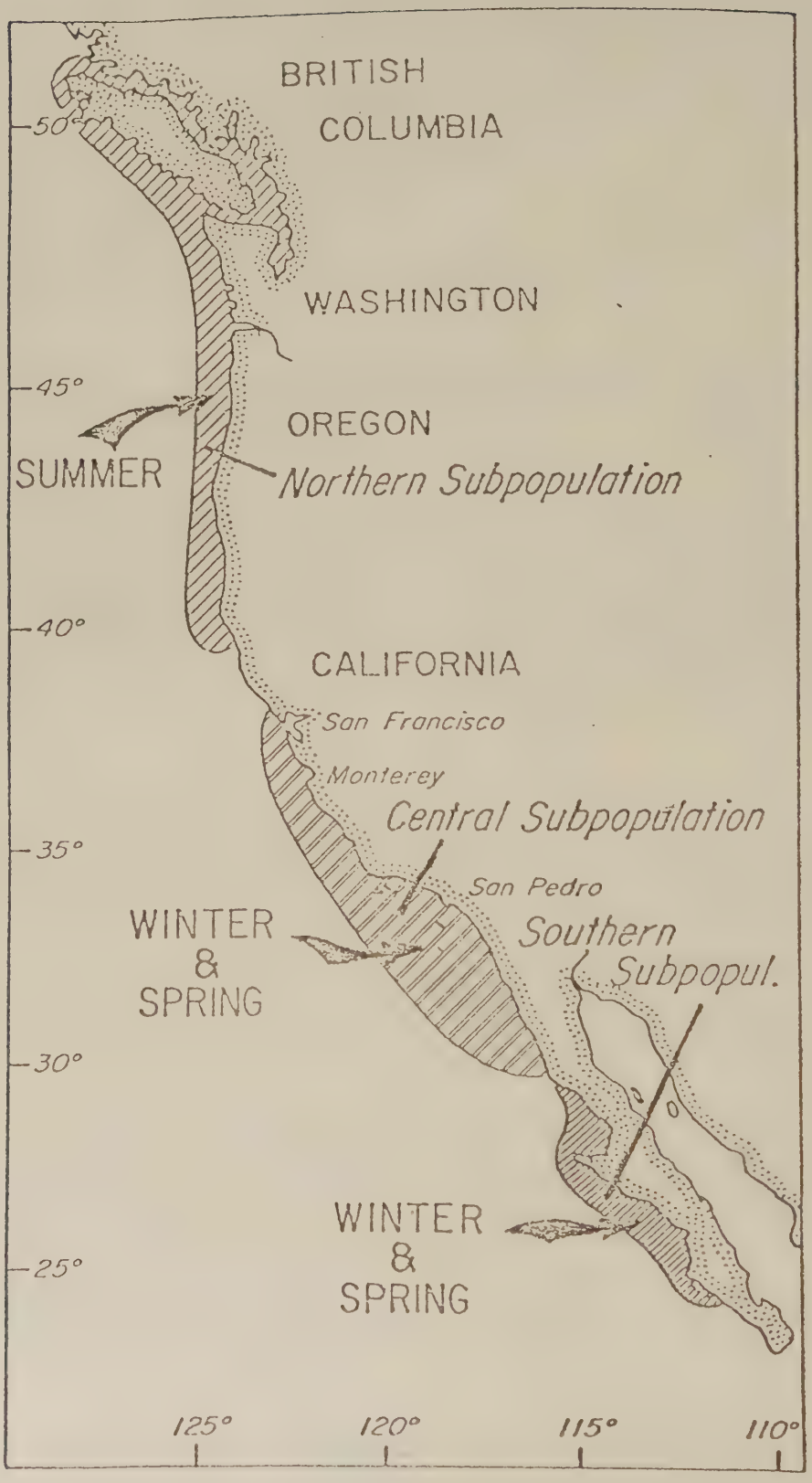


Fig. 1 Geographic distribution and spawning seasons of the three subpopulations of northern anchovy, Engraulis mordax.

Fisheries

Anchovy fisheries in both the US and Mexico can be categorized by the uses to which their catch is put. The largest volume of anchovy is caught for reduction to fish meal and oil. Much smaller amounts are caught for use as bait by commercial and recreational fishermen. Finally, a small portion of the total harvest is canned for human consumption. Anchovies command a higher unit price for the latter two uses.

The largest US catches are taken by the commercial "wetfish fleet" which fishes for reduction purposes. This fleet also fishes for sardines, jack mackerel, Pacific mackerel, bonito, bluefin tuna and squid, but anchovy accounts for the preponderance of the multi-species harvest. Vessels of the fleet range in length from 12 to 30 m and use round-haul nets (purse seine and lampara). Most of southern California vessels use purse-seine gear while vessels fishing in the Monterey Bay area occasionally use lampara nets.

Fishing effort for anchovies is mainly in southern California waters at present. Small and relatively stable catches are made in Monterey Bay. Several vessels land anchovies at Port Hueneme but the major reduction landings are made at Terminal Island. The principal areas of catch are the Catalina Channel and the Santa Barbara Channel. The California fleet fishing anchovies for reduction has fluctuated during recent years but the basic fleet has remained about 25 vessels. The purse-seine fleet is the remnant of a much larger fleet that harvested sardines. That resource disappeared in the 1950s, apparently because of over-fishing combined with very low recruitment over a period of several years.

The commercial anchovy fishery in Mexico is conducted by boats based at Ensenada. The anchovies taken are used for reduction and canning and a small amount may be taken for use as bait by the albacore fleet. The Mexican commercial fleet contains a number of rather small purse seiners, averaging less than 45 tonnes hold capacity. These vessels fish close inshore and relatively close to Ensenada. Part of the fleet consists of larger vessels that fish for anchovies part of the year, then move to the Gulf of California to participate in the sardine fishery. Six large purse seiners of 270 net-tonnes capacity joined the fleet in 1976 to fish anchovy on an all-year basis. The Mexican catch of anchovies grew rapidly during the late 1970s, due to the increased fishing capabilities and construction of new reduction-plant facilities at Ensenada.

Issues confronting Managers

Development of a fishery management plan for northern anchovy was prompted by the perceived need to address issues in three general categories: (1) conservation of the resource, (2) allocation among competing resource users, and (3) international consideration for a transboundary stock.

Many Californians are keenly concerned about protection of the anchovy resource, whether their primary interest is commercial or recreational fishing or the health of the coastal ecosystem in general. They recall the collapse of the California sardine resource and fishery (or have grown up hearing tales of the collapse) in the 1950s. The State fishery-management agency has been blamed by some for allowing over-fishing of sardines. As a consequence, recreational fishermen and conservation interests have organized on a local basis to ensure that interests, other than the short-term economic interest of commercial fisheries, are considered in fishery management decisions. A side effect of the sardine experience has been a readiness of interest groups to scrutinize carefully and to challenge the conclusions and biological opinions of government agencies. These groups certainly are a force in the management policy-making process.

Fishery managers and scientists involved with this anchovy fishery also are compelled to move cautiously with exploitation of this stock because of the experience of other nations with percipitous declines in similar fishery resources. The Peruvian anchovy experience is one case particularly familiar to these people.

One characteristic of the anchovy resource which influences management policy is that the abundance of spawners fluctuates widely over short periods. The fluctuation occurred even before a significant fishery existed. Management which relies on fixed regulatory measures such as fixed quotas would not satisfy the needs of the fishery or the resource from year to year. The resource can fluctuate to such an extent that the word "average" has little practical meaning for efficient management. If the average yield were harvested annually, the resource could be greatly over-fished in some years.

A parallel concern with protecting anchovy population productivity is providing a sufficient standing stock of anchovy to support large populations of higher predators. Anchovy are a food source for many species of larger fish which are important to commercial and recreational fishermen. Marine birds and mammals also rely on anchovy as forage to varying degrees. In addition to the public interest in maintaining large, healthy populations of these predator species, by maintaining a sufficient food supply, Federal law mandates that the needs of some predators be considered of higher priority than any fishery. Both the Marine Mammal Protection Act and the Endangered Species Act prohibit activities which would disadvantage or jeopardize the covered populations. Degradation of their habitat, including substantial reductions in their food supply, would violate these laws.

Since anchovy predators are opportunistic feeders for the most part, their diets consist mainly of anchovy when anchovy are abundant and of substitute prey when anchovy are not abundant. High levels of anchovy abundance are sufficient to support predators and a fishery.

Once it is determined that there are sufficient anchovy to fulfill the basic forage and reproductive needs, the question is what is the best use for the amount above that threshold level. The views on this issue fall into two divergent categories. One opinion is that the best use for any "surplus" anchovy is to bolster the forage supply. Those holding this opinion do not object to small volume fisheries for human consumption and for bait to be used by recreational and commercial fishermen. The other opinion on this issue holds that, if the basic reproductive and forage requirements are met, the anchovy above that level should be available for harvest. Those holding this opinion generally support the anchovy reduction fishery as a means of taking advantage of the anchovy "surplus".

The idea of catching fish for the purpose of reducing them to oil and meal is abhorrent to some people. In fact, California State law has prohibited the reduction of whole fish since 1919. The anchovy reduction fishery has been allowed to operate under special permits since 1965. Low ex-vessel values for anchovy to be reduced and the existence of substitutes for the end-products add to the arguments of those who believe the value of increased forage outweighs the value of a reduction fishery. However, a value for incremental increases in forage supply has not been calculated, nor is it likely that an objective value can be assigned.

The final major issue driving anchovy management policy is the complications arising from the transboundary distribution of this stock. Apparently the centre of the sub-population varies annually and through the season. Activities of the Mexican fishery and the US fishery impinge on the same stock and on each other. Both nations' fisheries have demonstrated their potential for harvesting large quantities of anchovy. As yet, peak fishing years for the two fleets have not coincided. One nation regulating its fishermen's efforts to catch a transboundary stock such as this will not be as effective as complementary, cooperative management by both nations.

Management objectives

After listening to the various interest groups and considering the National Standards for fisheries management, the Pacific Regional Fishery Management Council proposed a set of objectives to be met in anchovy fishery management. The following objectives are stated in the Anchovy Plan:

(1) To prevent over-fishing of the central sub-population of northern anchovy (Engraulis mordax) within the United States' Fishery Conservation Zone, and to promote conservation throughout its range.

(2) To allow a fishery for anchovies within the US Fishery Conservation Zone and to pursue such a fishery so as to achieve the optimum yield on a continuing basis.

(3) To maintain an anchovy population within the US Fishery Conservation Zone of sufficient size to sustain adequate levels of predator fish, birds and mammals.

(4) To avoid conflicts between US recreational and commercial fishermen.

(5) To promote efficiency in the utilization of the central sub-population of anchovies within the US Fishery Conservation Zone.

One unstated and underlying objective of the Plan was to define allocations of the anchovy resource in such a manner that annual changes in the total amount available for harvest would not require annual debates over the allocation principles.

Harvest quotas and allocations

The basic regulatory control on the US anchovy fishery is the annual quota. To address concern over the annual variation in the size of the anchovy stock, the overall quota hinges on the estimate of spawning biomass. The basic rules adopted for calculating the total optimum yield (OY) for the central sub-population of northern anchovy resource are as follows:

(1) If the spawning biomass (B) is less than 100,000 tonnes,
Optimum yield = 0

(2) If B is greater than 100,000 tonnes but less than 1,000,000 tonnes,
OY = 18,000 tonnes

(3) If B is greater than 1,000,000 tonnes,
OY = (B-1,000,000) ÷ 3 or
OY = 18,000 tonnes, whichever is greater

This harvest strategy was selected on the basis of impacts predicted by a bio-economic model of the fishery. That model (PFMC, 1978 - Appendix VI) was used to compare several alternative strategies, some more conservative and others more liberal than the one selected. Key impacts analysed were the effects on the mean biomass, the mean harvest and the number of years in which fishing would be prohibited due to low biomass.

This strategy was expected to provide first for protection of a spawning stock, then for small, high priority fisheries and for a portion (1/3) of the surplus to be used for lower priorities during years of high anchovy abundance. In this way, 982,000 tonnes of the first 1,000,000 tonnes were reserved for reproductive stock and to support predator populations. When the estimated spawning biomass exceeded one million tonnes, two-thirds of that excess is reserved from harvest as well.

The first allocation of the total quota among fisheries was an attempt to make a reasonable allocation of the central sub-population between the US and Mexico. In the absence of a negotiated agreement with the Government of Mexico, the Plan establishes an allocation unilaterally. Based on the average distribution of anchovy larvae, the US/Mexico allocation was set at 70:30. Given this division, 70 percent of the harvest at each level of spawning biomass is assigned to the US zone.

Allocations among uses within the US zone are ranked as follows:

(1) Bait and human food

(2) Domestic reduction industry (fishermen and processors)

(3) Domestic fishermen delivering to foreign processors

(4) Foreign fishermen

To date, anchovy has been taken only for priorities (1) and (2).

Announcement of quotas

The anchovy fishing year, for the purpose of accounting toward the quota, is 1 July through 30 June of the following year. Actual fishing for reduction begins on 1 August in Monterey and on 15 September for the major fleet in southern California. Given these opening dates, the annual quota should be announced before 1 August. In practice, a preliminary determination of spawning biomass, harvest quotas and expected harvests is published on 1 July for public review and comment. After considering the comments received, the final determinations are made and published on 1 August each year.

The biomass estimations are made each year by scientists at the National Marine Fisheries Service's Southwest Fisheries Center. A method for making these estimates was described by Smith (1972) and is summarized in Appendix I of the Plan (PFMC, 1978). New techniques have been developed since this Plan has been in effect (Parker, 1980; Stauffer and Picquelle, 1980). Since the newer method of biomass estimation is believed to be superior to the traditional method and yields substantially different estimates, some aspects of the Plan may need to be revised to accommodate our new perception of the anchovy resource. The basic concepts of a spawning biomass reserve, proportional harvest of the biomass in excess of the reserve and priority allocations among fisheries likely will be retained.

Other regulations employed

In addition to quotas, the anchovy reduction fishery is subject to seasonal and areal closures. Basically, the reduction fishery is prohibited from taking anchovies within three miles of the coast of southern California. That closure extends to six miles in some areas. There are other small area closures all of which have the same primary intent, that is to alleviate the potential conflicts with recreational and bait fisheries. An incidental benefit of these closures is protection of juvenile anchovy which tend to concentrate near shore. The seasonal closures were established to coincide with the peak spawning season (winter) and the height of recreational fishing activity (summer). The winter closure was motivated to some extent by a desire to avoid disturbing spawning aggregations but it also had a sound economic basis. Anchovy have lower oil content during the winter and are less valuable to processors. The summer closure reduces conflicts between commercial anchovy fishing and recreational fishing activity which peaks during the months of July and August. Those conflicts include competition for fishing space and for anchovy, which recreational fishermen value highly as bait.

Impacts of regulations

During the five years anchovy fishing has been regulated according to the current Plan, the quota has been reached only once and that happened very late in the season. According to the traditional method of biomass estimation on which quotas have been based, the population has been at relatively high levels of abundance since the mid-1970s. Consequently, the impact of harvest quotas on the resource and the fishery has been almost negligible to date. The quotas have increased public confidence that the fishery management agencies are monitoring and regulating the fisheries responsibly. With changing perceptions of the anchovy population and apparent declining abundance, harvest quotas will play an increasingly important role in regulating the reduction fishery. We remain confident that a combination of a spawning and forage reserve with a harvest quota based on annual biomass estimates will protect the anchovy resource and provide for predator populations, while allowing a reduction harvest when the resource is abundant.

This policy of setting annual quotas according to an established allocation formula was successful in easing debate when each year's quotas were announced. Debates resumed, however, with the introduction of a new fishery model.

The area and season closures have reduced the potential for direct conflict between recreational and commercial fishermen. Commercial fishermen have borne the cost of avoiding conflicts by foregoing fishing near to shore and during the summer months.

Administrative and enforcement costs

The cost of regulating the US anchovy fisheries according to the Northern Anchovy FMP includes the following:

	US $
Enforcement of closures	19,250
Enforcement of fish size limit	30,750
Fishery monitoring (vessel log-books, sampling and analysis of catch and quota accounting)	75,000
Total :	125,000

Costs associated with estimating spawning biomass on an annual basis vary according to the method of estimation. When the Plan was approved in 1978, the annual cost of conducting a larva census to estimate spawning biomass was approximately $556,000. Since that time, modifications in estimation techniques have reduced the amount of vessel and personnel time required. Currently, the cost of estimating spawning biomass by the egg-production method is expected to be approximately $200,000 annually. This cost could decrease substantially if the frequency of surveys were reduced to less than once a year. At present, the costs total to approximately $325,000 annually for biomass estimates, monitoring and enforcement.

Discussion

The principles by which the US anchovy fisheries are regulated were attractive to resource managers but the approach requires a great deal of information on the resource and the fisheries it supports. Ideally, there should be sufficient background to construct a functional bio-economic model for comparing alternative harvest strategies. Allocating the allowable harvest is facilitated greatly if managers, fishery participants and other interested parties have confidence in the model and the biomass estimation procedures.

In general, the management programme employed here is costly to implement. One research priority identified in the FMP was to develop more cost-effective systems for estimating the spawning biomass. Although a new method has been developed, it still is expensive to determine biomass reliably each year. We are exploring the possibility of using biennial or triennial surveys and indirect evidence (fishery data, etc.) to estimate abundance changes between surveys. If a mixture of methods proves acceptable, the frequency and expense of surveys can be reduced even further.

Two by-products of developing a more cost-effective method of estimating biomass were a more precise estimate and a refined understanding of anchovy population dynamics. That refined understanding significantly altered the bio-economic model and, when the revised model has been reviewed thoroughly, the FMP, regulations and allocation formulae will be amended. The basic principles, however, likely will be retained.

Perhaps the greatest short-term impact of changing the model and biomass estimates is a loss of confidence in the science on which the fishery regulations are based. In time that confidence will be restored but, while changes in the allocations are being considered, this lack of confidence on the part of the fishery participants will cloud the deliberations.

As troublesome as the re-evaluation of the domestic allocations may be, the unresolved issue of how to share the resource and management responsibility with Mexico is far more complex and critical for the effective management of this resource. While discussions among scientists from both countries have taken place in the past, meaningful progress toward joint or complementary management has not been made. This lack of progress is due, in part, to tuna-management related problems creating a less than productive atmosphere for other fishery negotiations and to the differences in management goals between the two nations. Whatever the cause, the lack of agreement is delaying effective management and protection of the entire central anchovy sub-population.

References

Ahlstrom, E.H., 1968 An evaluation of fishery resources available to California fishermen. Univ.Wash.Publ.Fish., (4):65-80

Mais, K.F., 1974 Pelagic fish surveys in the California Current. Fish Bull.Calif.Dep.Fish Game, (162):72 p.

Miller, D.J. and R.M. Lea, 1972 Guide to the coastal marine fishes of California. Fish Bull.Calif.Dep.Fish Game, (157):249 p.

PFMC (Pacific Fishery Management Council), 1978 Northern anchovy fishery management plan. Fed.Reg., 43(141):31655-783

Parker, K.R., 1980 A direct method for estimating northern anchovy, Engraulis mordax, spawning biomass. Fish.Bull. NOAA/NMFS, 78:541-4

Smith, P.E., 1972 The increase in spawning biomass of northern anchovy, Engraulis mordax. Fish.Bull.NOAA/NMFS, 70:849-874

Stauffer, G.D. and S.J. Picquelle, 1980 Estimates of the 1980 spawning biomass of the central sub-population of northern anchovy. Admin.Rep.Southwest Fish.Cent.,(LJ-80-9):41 pp.

Vrooman, A.M., P.A. Paloma and J.R. Zweifel, 1981 Electrophoretic, morphometric and meristic studies of sub-populations of northern anchovy, Engraulis mordax. Calif.Fish Game, 67:39-51

Vrooman, A.M. and P.E. Smith, 1971 Biomass of the sub-populations of northern anchovy, Engraulis mordax Girard. CALCOFI Rep.,(15):49-51

Table 1. Yearly California Anchovy Landings

Year	Tonnes	Year	Tonnes
1916	241	1949	1,510
1917	239	1950	2,213
1918	394	1951	3,154
1919	730	1952	25,303
1920	259	1953	38,935
1921	883	1954	19,237
1922	296	1955	20,272
1923	140	1956	25,819
1924	158	1957	18,392
1925	42	1958	5,263
1926	27	1959	3,254
1927	167	1960	2,294
1928	162	1961	3,498
1929	173	1962	1,254
1930	145	1963	2,073
1931	140	1964	2,257
1932	136	1965	2,600
1933	144	1966	28,250
1934	117	1967	31,575
1935	82	1968	14,096
1936	89	1969	61,362
1937	103	1970	87,310
1938	334	1971	40,690
1939	974	1972	62,687
1940	2,866	1973	120,327
1941	1,862	1974	75,040
1942	768	1975	143,800
1943	712	1976	113,327
1944	1,765	1977	101,131
1945	733	1978	11,457
1946	872	1979	53,244
1947	8,591	1980	49,037
1948	4,915	1981	52,011

Table 2. Anchovy Landings at Ensenada, Baja California

Year	Tonnes	Year	Tonnes
1965	9,171	1974	39,826
1966	13,243	1974	55,251
1967	20,104	1976	75,760
1968	14,267	1977	142,211
1969	3,871	1978	142,000
1970	27,977	1979	205,000
1971	20,079	1980	246,000
1972	32,640	1981	259,000
1973	14,853	1982*	170,000

* preliminary

Table 3. Commercial Landings and Live-Bait Catch of Anchovies in California, 1939-1981 (metric tons)

Year	Commercial landings*	Live-Bait	Total	Percent Live-Bait	Number of Live-Bait Boats Reporting
1939	974	1,364	2,228	58.3	--
1940	2,866	1,820	4,686	38.3	30
1941	1,862	1,435	3,297	43.5	--
1942	768	234	1,002	23.4	9
1943	712	--	712	--	--
1944	1,765	--	1,765	--	--
1945	733	--	733	--	--
1946	872	2,493	3,365	74.1	--
1947	8,591	2,589	11,180	23.2	--
1948	4,915	3,379	8,294	40.7	25
1949	1,507	2,542	4,049	62.8	23
1950	2,204	3,469	5,673	61.1	25
1951	3,154	4,665	7,819	59.7	22
1952	25,303	6,178	31,481	19.6	24
1953	38,935	5,798	44,733	13.0	30
1954	19,237	6,065	25,302	24.0	23
1955	20,272	5,557	25,829	21.5	22
1956	25,819	5,744	31,563	18.2	18
1957	18,392	3,729	22,121	16.9	17
1958	5,263	3,843	9,106	42.2	24
1959	3,254	4,297	7,551	56.9	16
1960	2,294	4,225	6,519	64.8	13
1961	3,498	5,364	8,862	60.5	16
1962	1,254	5,595	6,849	81.7	22
1963	2,073	4,030	6,103	66.0	23
1964	2,257	4,709	6,966	67.6	22
1965	2,601	5,645	8,246	68.5	24
1966	28,250	6,144	34,394	17.9	18
1967	31,575	4,898	36,473	13.4	16
1968	14,096	6,644	20,740	32.0	19
1969	61,362	4,891	66,253	7.4	10
1970	87,310	5,543	92,853	6.0	11
1971	40,690	5,794	46,484	12.5	11
1972	62,687	5,307	67,994	7.8	12
1973	120,327	5,639	125,966	4.5	12
1974	75,040	5,126	80,166	6.4	14
1975	143,800	5,577	149,377	3.7	14
1976	113,327	6,202	119,529	5.2	13
1977	101,131	6,410	107,541	6.0	13
1978	11,457	6,013	17,470	34.4	13
1979	53,244	5,364	58,608	9.2	13
1980	49,037	4,921	53,958	9.1	13
1981**	51,985	4,249	56,234	7.6	

* for all uses
** preliminary

MANAGEMENT OF THE ATLANTIC SURF CLAM FISHERY UNDER THE MAGNUSON ACT, 1977 TO 1982

by

Bruce Nicholls
Surf Clam Management Coordinator
National Marine Fisheries Service
Northeast Region
Gloucester, Massachusetts, USA

Introduction

The Fishery Management Plan for Atlantic Surf Clams (Spisula solidissima) and Ocean Quahogs (Arctica islandica) was one of the first management programmes to be implemented under the authority of the Fishery Conservation and Management Act of 1976 (now known as the Magnuson Act), which established a 200 nautical mile fishery management zone off the United States coast. The plan, implemented on 17 November 1977, regulates what has always been an entirely domestic fishery. Conservation measures established under the plan have been influential in increasing allowable harvests over 30 percent.

The primary management measure applied to the fishery is an annual harvest quota. The quota is supported by a host of other measures, which were designed to mitigate potential adverse economic impacts of the planned reduction in catch during the stock-rebuilding phase of management. Some of the measures were originally intended to be short-term attempts to stabilize the social and economic aspects of the fishery while the restrictive conservation programme was carried out. Now, managers face the difficult task of replacing short-term measures with appropriate long-term objectives for management. National policy concerning potentially controversial economic issues, such as long-term or permanent limited entry for marine commercial fisheries, has yet to be firmly established. Managers contemplating the fishery and its problems must now consider untested alternatives in their attempt to develop a practical and workable scheme for long-term management for optimum biological, social and economic yield from the fishery.

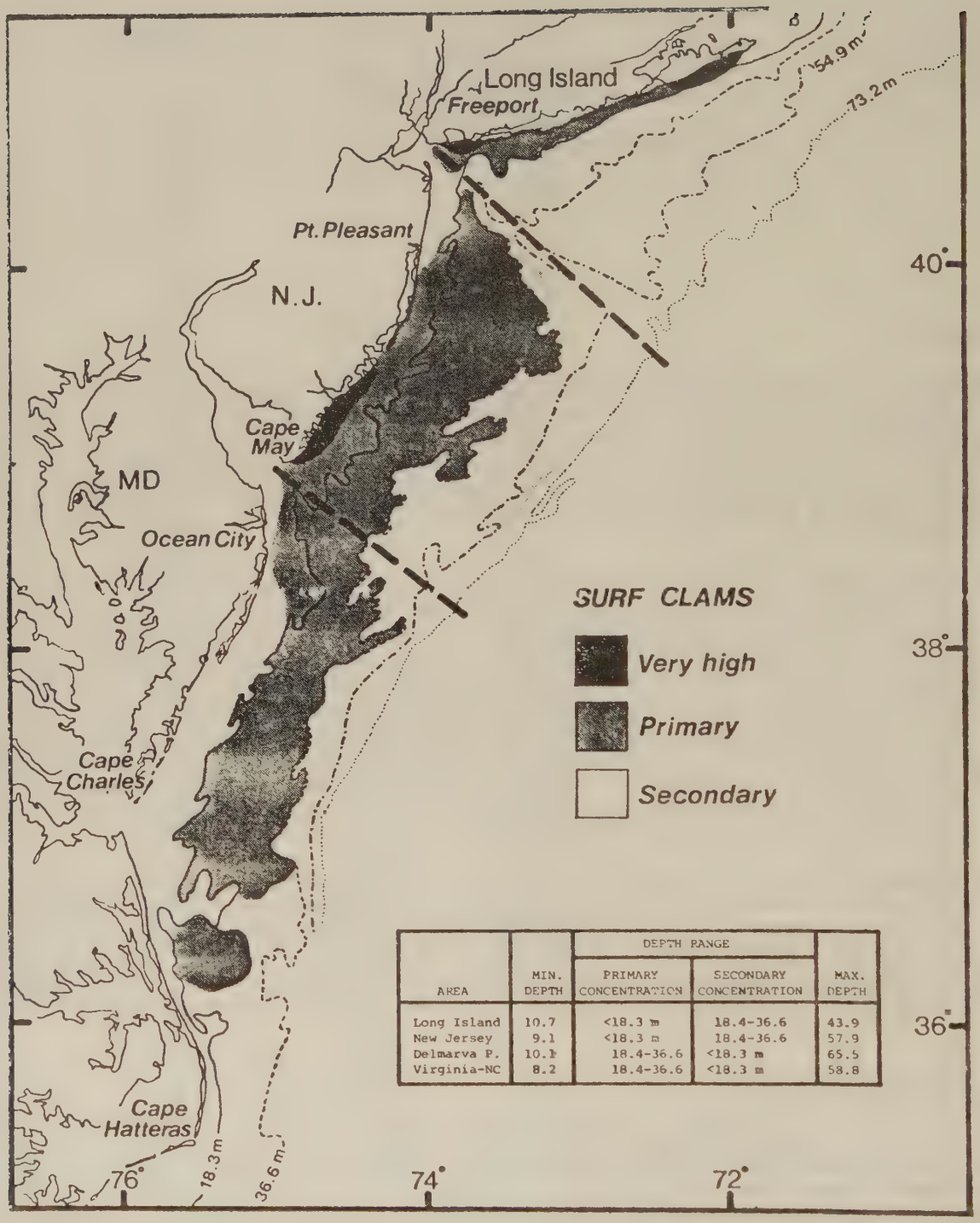
The management programme described in this paper applies to both the surf clam and the ocean quahog fisheries of the Northwest Atlantic Ocean under the jurisdiction of the United States. The ocean quahog fishery during the period discussed has been managed under provisions of the management plan, but harvests of this resource have not yet reached the point where restrictive measures such as those now imposed for surf clams need to be imposed on ocean quahog fishermen. Therefore, most of the management experience discussed in this paper concerns only the surf clam fishery.

Description of the Surf Clam

The surf clam, Spisula solidissima, is a predominantly oceanic bivalve mollusc commonly occurring from the beach zone to depths as great as 60 metres. The greatest concentrations occur along the Atlantic coast of the United States from the Gulf of Maine south to Cape Hatteras (Figure 1), although surf clams have been described as ranging from the southern Gulf of St. Lawrence to the northern Gulf of Mexico (Ropes, 1980).

Surf clams burrow in the substrate to a depth about equal to their shell length. They reach maturity during their second year of life and reach the generally accepted commercial harvest size after six to seven years. Commercial size is about 130 mm shell length.

Surf clams, when shucked, yield about 7.7 kg of meat and viscera per bushel. The surf clam bushel is a unique unit of measurement measuring 0.052 cubic metres in volume. Edible meat yield per bushel varies according to season and location of harvest but averages 5.9 kg.



AREA	MIN. DEPTH	DEPTH RANGE		MAX. DEPTH
		PRIMARY CONCENTRATION	SECONDARY CONCENTRATION	
Long Island	10.7	<18.3 m	18.4-36.6	43.9
New Jersey	9.1	<18.3 m	18.4-36.6	57.9
Delmarva P.	10.1	18.4-36.6	<18.3 m	65.5
Virginia-NC	8.2	18.4-36.6	<18.3 m	58.8

Source: Ropes, 1980.

Figure 1 Distribution of Surf Clams in the mid-Atlantic Bight

Surf clams have been harvested with a variety of gear, including hand tongs, dry dredges and the more recent hydraulic jet dredge (Parker, 1971). The latter gear, now responsible for virtually all harvests, washes the surf clam clear of the substrate with a high pressure jet of water. Hydraulic dredges have reached a considerable degree of sophistication, with some dredges now in use measuring over 5 metres in knife width.

History of the Surf Clam Fishery

The surf clam fishery, off the Atlantic coast of the United States, has a history dating back to the 1870s, when surf clams were harvested off Cape Cod for use as bait and food. Major commercial development of the fishery occurred on Long Island before, during and after World War II, with development of the hydraulic clam dredge and processing equipment to wash sand from clam meats. In 1949, industry exploration yielded new beds off the New Jersey coast. The fishery off New Jersey expanded greatly, reaching major proportions off the ports of Point Pleasant, Barnegat, Atlantic City and Cape May, New Jersey, through the 1950s and 1960s (Ropes, 1982).

By the early 1960s, the industry suspected that the known resource was being depleted. A joint research programme, supported financially by industry and the Federal Government, was initiated to determine the overall extent of the resource available for future exploitation. Exploratory surveys in 1965 discovered significant new beds in the offshore regions off the Delmarva Penninsula (Delaware, Maryland and Virginia) and the fishery expanded offshore and to the south. During a 1969 survey, new beds were identified off Cape Charles, Virginia. These beds were quickly exploited, providing the highest landings ever recorded from the fishery in the period from 1972 through 1975. The history of the fishery has thus been one of significant and rapid expansion southward along the coast, following the discovery of new beds, and in many respects resembled a pulse fishery during this period of development. By the mid-1970s, the fishery had reached the furthest limit of the southern extension of the resource near Cape Hatteras, North Carolina.

History of Management of the Fishery

United States Public Law 88-308, enacted in 1964, prohibited foreign harvest of the creatures of the continental shelf off the United States. Continental shelf resources were defined by the United Nations Conference on the Law of the Sea Convention on the Continental Shelf in 1958. In 1971, surf clams were listed by the United States as a protected species under that authority (Ropes, 1980).

Direct management of the surf clam resource for conservation was initiated in the early 1970s. In 1971, the State of New Jersey, concerned about the rate of development of the fishery, which was clearly able to deplete the resource if left uncontrolled, asked the federal government to initiate a cooperative State-Federal management programme. That effort began in 1973 and provided an open forum for wide ranging discussions of management needs and alternatives between State, Federal and industry participants. The sincere and continuing concern of industry participants concerning the future of their fishery, and the limited number of participants in the industry, contributed to frank and open discussion. Recommendations for stringent management measures were developed with industry approval. However, implementation of management measures was hampered by the complexity of jurisdiction, since the resource occurred in the waters of several States and offshore where no institutional management authority then existed. In 1975, New Jersey independently enacted regulations to control the harvest of surf clams in New Jersey territorial waters, extending to 3 nautical miles from the shoreline.

In 1976, the passage of the Fishery Conservation and Management Act (now the Magnuson Act) provided a new vehicle for implementation of comprehensive marine fishery management programmes. The mid-Atlantic Fishery Management Council, one of eight established under the Act to develop management policies and strategies, quickly took the task of developing a fishery management plan for the surf clam fishery. The scope of management was broadened to include the ocean quahog fishery, which occurs further offshore, with the recognition that that fishery could rapidly develop. With development, the fishery could serve as an alternative source of clam meat for consumers and a vast resource base to support the vessels, processors and fishermen which might be displaced from the depleted surf clam fishery.

The Council used the recommendations developed under the previously mentioned State-Federal programme as the basis for its own efforts, and a Council plan was written, submitted for public review, revised, approved and implemented by the Federal Government on 17 November 1977. Since that time, the Council has prepared and adopted three amendments to the plan, all of which have been implemented. The first was a minor action to extend the plan for a few months in 1979, while the second amendment was being prepared. The second refined a number of management measures and extended the plan through 1981. The third amendment, implemented in late 1981, is a permanent plan with no date of expiration. That amendment established a procedure for setting fishery quotas annually and imposed a minimum size limit of 140 mm for surf clams.

Measures included in the Management Plan

The original plan contained a number of management measures. The primary conservation measure was an annual quota. A procedure to close certain areas where significant numbers of small surf clams were concentrated served to protect juvenile clam beds, when identified, from exploitation and the damage inflicted by dredging and culling.

The remainder of the measures in the plan were included to stabilize the social and economic aspects of the fishery. These measures included a moratorium on the issuance of new fishing permits. This was the first use of any form of limited entry in a Federal Fishery Management Plan. The plan authorized permits only for those vessels that were active in the fishery during the year prior to implementation and for those vessels that were being built or re-rigged to enter the fishery on the day the plan went into effect. Eventually, 184 vessels applied for and received surf clam permits.

Other stabilizing measures included a provision to administer the annual quota as a series of quarterly quotas. The annual quota was divided in unequal quarterly quotas reflecting the expectation that greater fishing activity and harvest would occur from the late spring through early fall. Also, fishing time for all vessels could be restricted to whatever number of hours per week the Regional Director of the National Marine Fisheries Service, who was charged with implementing and enforcing the plan, determined would be needed for the entire fleet to harvest the quarterly allocation. Progress toward harvest of the quotas was monitored on a weekly basis, and allowable fishing time during each quarter was increased or reduced to ensure that the quota would be taken, but not exceeded, and that the quota would last through the entire quarter. Closure of the fishery was always judged as a serious problem to be avoided because of the significant economic impact it would have on employees of processing plants, who receive low wages and are only paid when work is available.

A mandatory log-book reporting programme, which required weekly reports of catch, value, effort and marketing of catch from both harvestors and processors, was used to monitor fishery progress and gain additional information about the distribution of fishing pressure on the resource and about the economic character of the fishery.

Most other Fishery Management Plans developed under the Magnuson Act have sought to attain their conservation objectives with fewer control measures. A simple annual harvest quota, properly calculated and firmly administered, could probably have attained the same conservation results as did all the various management measures in the surf clam plan taken together. However, no such simple quota would have been acceptable to the entire fishing community because of its economic impacts. The Council recognized that, with the limited quota they proposed, they would have to offer present and future security and stability to the existing industry as compensation for the immediate reduction of fishing opportunity.

In retrospect, the use of limited entry in this plan to prevent further growth in the number of vessels and workers dependent on the fishery, and the use of restrictive effort-controls to spread harvests over the entire course of each fishing year, ensured the success of quota management in the fishery. The small number of vessels and processors involved at the time (about 150 vessels and 20 processors) ensured that controls could be imposed on a direct and personal level. Discussions of management problems and alternatives as they occurred could be considered in a forum where all participants had already achieved some understanding of the complexity of the issues and the consequences of actions taken.

Operation of the Quota

Quota management of the surf clam fishery has been basically successful. A large part of the credit must go to the Mid-Atlantic Fishery Management Council for its wisdom in specifying a coherent and balanced management programme and for its determination to stand by the programme throughout its early implementation until long-term results were apparent. The Council directly addressed, using the best information available at the time, the issues of economic survival and equitable allocation to the fishermen and processing workers who depended on the resource for a livelihood. This allowed the government to enforce strictly the quota which was the primary conservation measure.

The actual quota as initially established was essentially a compromise between the minimum needs of the industry, estimated at the time to be 15,900 tons of shucked meats, and the advice of scientific advisors, who were concerned that the resource was in such danger that the fishery should be limited to 4,500 tons, to provide for immediate re-building of the resource (Rinaldo, 1977).

The Council selected a 13,600 ton quota and applied it on an annual basis for the two years following plan implementation. When established, the quota level represented a significant risk. The prospects for recruitment in 1976 and 1977 were unknown. Only in retrospect do we know that two significant year-classes were spawned in those years. The Council's action in selecting a quota closer to the needs of the industry than the estimates of the scientific advisors would have had serious consequences for the resource if recruitment had not occurred. However, a reduction of harvests to 4,500 tons might well have destroyed the surf clam industry. If the stock were protected but the industry destroyed, the management programme might not later have been judged a success.

Surf clam landings are measured by the industry in bushels. The appropriate conversion from tonnes to bushels yielded an annual allowable harvest of 1.8×10^6 bushels. Since the plan was implemented mid-way through the fourth calendar quarter of 1977, the quota for the remainder of 1977 was set at a fraction of the annual and quarterly quotas which would have applied. Annual quotas for 1978 and 1979 were set at 1.8×10^6 bushels. A subsequent amendment to the plan extended that quota level through 1980 and 1981 (Table 1).

Table 1

Surf clam and ocean quahog landings from the Fishery Conservation Zone, 1971-1981 (in tons of meat)

Year	Surf Clams			Ocean Quahogs		
	Quota	Landings	% Change	Quota	Landings	% Change
1971		22,700				
1972		28,800	27			
1973		32,900	14			
1974		33,800	3			
1975		19,800	-41			
1976		19,300	-2		1,900	
1977		19,600	2		7,200	287
1978	13,600	14,200	-27	13,600	9,200	28
1979	13,600	13,200	-7	13,600	14,300	56
1980	13,600	15,700	19	15,900	13,900	-3
1981	13,600	16,900	8	18,100	16,000	15

Source :
Mid-Atlantic Fishery Management Council, 1982. Revised to metric equivalents.

Before the end of 1977, it was apparent that the fishery could not be conducted for more than 48 hours per week per vessel without exceeding the quota. Fishing time was reduced, initially to 48 hours per week and finally to 24 hours per week. With a 24-hour fishing week, most vessels operated for two 12-hour fishing trips per week. Despite these restrictions, two brief periods of closure were imposed, one for three weeks in March of 1978 and one for one week at the end of 1978. The quota was still exceeded by about 3 percent, requiring subtraction of the overage from the 1979 quota.

During 1979 the market for surf clams was poor and closures were not required to avoid exceeding the quota levels. Despite the poor markets, however, fishing time was still restricted to an average of only 28 hours per week during the year (Table 2). In 1980, the quota was exceeded by about 10 percent, due to the discovery of dense beds of juvenile clams which boosted catch rates significantly. In 1981, the quota was reduced by about 10 percent to account for the 1980 overage. This action, in combination with later events, set the stage for the biggest crisis in management under the plan.

Table 2
Allowable surf clam fishing time - 17 November 1977 to 31 December 1982

Effective Date	Allowable Time (hours/vessel/week)	No. of weeks	No. of hours
1977 : 17 November	48	6	288
Total 1977	48	6	288
1978 : 1 January	96	4	384
30 January	48	6	288
10 March	Closure	3	0
1 April	48	5	240
7 May	24	21	504
1 October	36	4	144
30 October	24	8	192
21 December	Closure	1	0
Total 1978	34	52	1,752
1979 : 1 January	24	9	216
27 February	36	5	180
1 April	24	27	648
15 October	36	11	396
Total 1979	28	52	1,440
1980 : 1 January	24	9	216
18 February	36	6	216
31 March	24	3	72
20 April	36	4	144
18 May	48	6	288
29 June	24	1	24
7 July	48	9	432
28 September	24	14	336
Total 1980	33	52	1,728
1981 : 1 January	24	29	696
21 July	12	23	276
Total 1981	19	52	972
1982 : 3 January	24	52	1,248
Total 1982	24	52	1,248

Source :
Mid-Atlantic Fishery Management Council, 1982

By May of 1981, landing statistics from the fishery showed clearly that the annual quota would be exceeded as soon as September of that year. Fishing time was already restricted to only 24 hours per week and a further reduction of hours was considered impractical, since it would leave the fishermen with only one fishing trip per week. When the industry recognized that closure for a substantial part of the year might occur, catch rates actually increased in order to provide a cushion of inventory during any possible closed period. This only aggravated the situation. Part of the reason landings had increased was because recruitment from the abundant 1976 year-class occurred in dense beds which supported high catch rates. This allowed fishermen to sell their clams at a lower price, making clams more attractive to buyers, without sacrificing income, since restrictions on individual vessels apply to fishing time rather than total landings. Eventually, of course, fishing time for all vessels would have to be reduced, but an individual fisherman had little incentive to reduce his fishing effort when he knew that another fisherman could and probably would land more to compensate for his own sacrifice (Table 3).

Table 3
Surf clam vessel performance, 1979-1982

Year	Tonnage Class	No. of vessels	Bushels	Bushels/ vessel	Hours fished/ vessel	Bushels/ hour fished
1979	0-50	28	101,320	3,619	202	18
	51-100	56	366,643	6,547	331	20
	101+	81	1,200,294	14,818	481	31
Total :		165	1,682,636	10,198	386	26
1980	0-50	14	80,134	5,724	264	22
	51-100	47	491,278	10,453	419	25
	101+	67	1,377,403	20,558	540	38
Total :		128	1,948,815	15,225	465	33
1981	0-50	16	67,469	4,217	188	22
	51-100	41	459,248	11,201	286	39
	101+	66	1,490,715	22,587	409	55
Total :		123	2,017,432	16,402	340	48
1982	0-50	12	45,142	3,762	172	22
	51-100	36	183,637	5,101	207	25
	101+	52	571,985	11,000	276	40
Total :		100	800,764	8,008	239	34

Note : Data for 1982 cover year through 30 June

Source : Mid-Atlantic Fishery Management Council, 1982

After considerable deliberation, scientists and managers agreed that incoming recruitment would support a 30-percent increase in the 1981 annual quota without endangering the re-building process. To spread out that increased catch over the remainder of the year and avoid closure of the fishery, fishing was restricted to 12 hours per week and, for the first time, a new restriction was added in the form of

a minimum landing size of 140 mm. 1/ Both of these measures were included in Amendment 3 to the management plan, which was in the final stages of public review. Together, these measures achieved the desired control of harvest and the adjusted 1981 quota was not exceeded.

Refining the Quota Process

In 1980, the Council began to consider a management programme for maintaining the resource over the long term, recognizing that recovery of the resource had begun and could be expected to continue. Recognition had also developed at the national level that the management planning process was lengthy, involving significant lead times for Council deliberation, industry review and comment and Federal approval. The time required to develop, review and implement a management plan or a formal amendment to a plan was at least 270 days, under the most optimistic projection that the Council, industry and government had no critical objections to the recommendations contained in a plan or amendment.

Resource-assessment surveys for the most economically important fishery resources were now generally conducted annually by fishery biologists operating from the Northeast Fisheries Center in Woods Hole, Massachusetts. The results of the assessments could theoretically and, in fact, often did show that the quotas established by a management plan developed two years in the past and implemented one year in the past were no longer entirely valid.

Because of this time lag, a more flexible system was accepted as necessary and able to offer important advantages. Flexibility would not be broad or directed at major changes in management philosophy but would be used to adjust and refine measures, within defined bounds, which had already been studied for their social and economic ramifications. The concept was advanced as a matter of national policy by the National Marine Fisheries Service. The Council was encouraged to develop a flexible mechanism for setting quotas and making other management adjustments. This concept was termed a framework plan.

Each fishery management plan must, by law, define the optimum yield of the managed fishery for the life of that plan. The Mid-Atlantic Fishery Management Council recognized that optimum yield for the surf clam fishery could be established as a range of harvests, with a lower limit as the minimum needs of the industry to sustain itself and satisfy existing markets and an upper limit as the level which the Council hoped to achieve through re-building of the stock and continued wise management. In the original plan, the Council had stated that the long-term yield from the fishery was expected to equal the average harvest over the years 1970 through 1976, or 22,700 tonnes. After several years of management experience, the industry had accommodated itself to marketing a minimum of 13,600 tonnes of surf clam meat annually. Thus, the new amendment, Amendment 3, established a range for optimum yield for the surf clam fishery of 13,600 to 22,700 tonnes. During the life of the amendment, quotas could be specified annually as any value within that range, thus providing the flexibility needed to respond to changing resource conditions.

A deliberative process, incorporating the best scientific information and reasoned judgement on the part of managers, is essential under the framework-plan concept, to prevent wide fluctuations between resource recovery and depletion. A formal procedure gives due consideration to the scientific information available, appropriate consideration to the needs of the consumer, recognition of the current economic status of the industry and a longer-term view of the cyclical trends in availability and abundance. In the case of the surf clam plan, the Council specified a set of criteria to be used by the Regional Director of the National Marine Fisheries Service to set annual quotas for the fishery.

1/ The 140 mm minimum landing size was promoted on the grounds that it would optimize yield per recruit. Maximum yield per recruit for surf clams occurs at a smaller size but the highest commercial value is obtained from meat strips derived from surf clams greater than 140 mm in length. The practical effect of implementing the size limit was to sharply reduce the portion of the resource that could be harvested. The fishermen thus experienced reduced harvest rates and so the new quota was sufficient to last through the remainder of the year.

The final authority to establish the quotas was vested with the Regional Director, to isolate the decision to the extent possible from the kind of short-term pressures which could be generated in a forum dominated by industry. The Regional Director's objectivity is assumed because of his broad responsibilities to carry out the intent of the management programme and the constraints of administrative process and procedure which prevent him from taking actions which exceed his authority. If the criteria and facts to be considered are clearly and completely specified as a matter of policy by the Council, implementation by the Regional Director should constitute a ministerial function.

The procedure required the Regional Director to prepare a report each year, based on the latest available stock assessment prepared by scientists from the National Marine Fisheries Service's Northeast Fisheries Center, required landing data reported by harvestors and processors and any other relevant information. The report must include consideration of the following key fishery indicators:

(1) Exploitable biomass and spawning biomass relative to optimum yield

(2) Fishing mortality rates relative to optimum yield

(3) Magnitude of incoming recruitment

(4) Projected effort and corresponding catches

(5) Status of areas previously closed to fishing to protect small clams, that are to be opened during the year and areas likely to be closed during the year

The Regional Director's report is provided to the Council and, after consultation between the Regional Director and the Council, the Regional Director publishes proposed quotas for public review and comment. The public has 30 days to comment, after which all comments are considered and a final quota is established and published for public notice. The entire process normally takes about 60 days, if unforseen delays are not encountered.

This procedure was used to establish a quota for surf clams for 1982 and 1983. The procedure appears to have been effective. The harvest of surf clams in 1982 fell short of the quota by about 10 percent.

Economic Consequences of the Quota

In 1977, processors and harvestors of surf clam products were well aware of the impending implementation of the plan and of the basic measures it would include. In addition, the fishery was experiencing a rapid decline in landings as the last of the large beds of clams off Southern Virginia were depleted. Inventories of surf clam products were accumulated by the processors at practically any cost through 1976 and 1977, in anticipation of scarcity in the period ahead. As a consequence, the price of surf clams advanced significantly at the vessel, wholesale and consumer levels.

From 1965 through 1974, clam meat prices were stable, between 18 and 22 cents per kg in deflated dollars (adjusted to remove the effects of inflation, based on prices in 1967 as the base level). In 1976, prices rose from 18 cents to 57 cents per kg in deflated dollars, an increase of over 200 percent in one year. Since that dramatic increase, prices have showed no distinct trend in current dollars, but inflation has reduced those current dollars to a deflated price of 37 cents per kg in 1981. Further inflation and any reduction in prices which may occur as the quota rises and meat becomes more available will probably result in deflated prices comparable to the levels prevailing through the 1960s and early 1970s (Table 4).

Vessel operators experienced a very definite change in their status with respect to processors and in their gross income as a result of both the natural decline of the resource and the quota-imposed reduction of harvests. Processors have traditionally held the upper hand in dealing with clam boats, since clams are caught and supplied through long-term direct arrangements bteween vessel and processor rather than through an open market. Excess capacity and some vertical integration allowed processors to keep the price to the vessel very low. All this changed abruptly when clams became scarce. Fishery landings declined from 1975 to 1976 by less than 45 percent but ex-vessel prices more than tripled. Since that increase in price, the fisherman's price has remained generally unchanged in current dollars, with some signs of weakening in 1979 and 1982. The deflated value to the fisherman has thus declined as a result of persistent inflation over the last six years.

Table 4

Surf clam prices per kg, 1960-1981

Year	Price in Current Dollars	Price in Deflated Dollars
1960	.15	.15
1961	.13	.15
1962	.15	.15
1963	.15	.15
1964	.15	.15
1965	.15	.18
1966	.20	.20
1967	.22	.22
1968	.22	.22
1969	.26	.24
1970	.24	.22
1971	.29	.24
1972	.26	.22
1973	.26	.20
1974	.29	,18
1975	.31	.18
1976	1.04	.57
1977	1.15	.60
1978	1.17	.55
1979	1.23	.53
1980	1.12	.42
1981	1.12	.37

Source :
Mid-Atlantic Fishery Management Council, 1982
Revised to metric equivalents.

Deflated prices calculated using producer prices, all commodities, 1967 = 100 (US Department of Commerce, Bureau of Economic Analysis, Business Conditions Digest, Series 330).

The principal reason for the failure of deflated prices to remain stable or increase during the last several years is the significant development of the ocean quahog fishery which occurred concurrent with imposition of the management programme. The ocean quahog fishery grew from nominal landings in 1975 to approximately equal the meat yield of surf clams in 1981. Ocean quahogs can thus far only be substituted for certain surf clam products, including chowders, minced clams and juices. This substitution factor is readily evident in the compound growth rate for prices of those products. While prices for surf clam based breaded clams have risen at a compound deflated rate of 15 percent, products which can be made with ocean quahogs have risen at a compound deflated rate of only 1 or 2 percent. The growth of the ocean quahog fishery can be counted as a major success of the management programme, since it has significantly expanded the amount of clam products available to the consumer, keeping prices for those products well below the levels which might otherwise have occurred (Table 5). The ocean quahog fishery also served as an important source of alternative employment for many of the larger vessels in the surf clam fleet. As they moved out of the surf clam fishery, more of the surf clam resources was available for harvest by the vessels which remained in the fishery, reducing the impact of the reduction in total allowable surf clam harvests.

Table 5

Compound growth rates of production value of clam based products, 1970-1979

Product	Undeflated (%)	Deflated (%)
Canned clam chowder	9	1
Canned minced clams	10	2
Frozen breaded cooked clams	24	15
Frozen breaded raw clams	26	16
Clam juices	17	8

Source :
Mid-Atlantic Fishery Management Council, 1982

Enforcement and Administration of the Management Plan

Very shortly after the first management plans were implemented under the authority of the Magnuson Act, it was apparent that enforcement of management provisions was much more effective and had a higher probability of success if conducted at the dock rather than at sea. Monitoring fishery activity at sea requires observation, through enforcement or compliance inspectors on board the fishing vessel, or through vessel or aerial inspection of the fishing activity. When jurisdictions over fishing activities are split, as is the case when State and Federal regulations are not complementary, surveillance may have to stretch over the duration of the fishing trip to ensure compliance and provide enforcement officials the evidence they need to result in successful prosecutions.

At the simplest level, enforcement of the surf clam plan could theoretically be handled through dockside inspection. Once the quota had been landed, the fishery could be closed. Since surf clam vessels working at sea are readily identified by their location, vessel and gear configuration, any vessel operating after a closure could be cited for a violation.

In practice, the provisions of the management plan which were intended to spread harvests out over the course of the year complicated this enforcement effort, since they required that vessels be continuously monitored at sea to determine if they were fishing on their designated fishing days. Monitoring the time of departure and arrival at the dock is not effective, since some vessels must leave the dock many hours before they will fish, both to allow for steaming time to distant and diverse fishing grounds and to allow the larger vessels to clear shoal waters and navigational impediments at high water or with favourable tides. The plan attempted to facilitate enforcement by providing for long-term advanced scheduling of fishing activity, so that enforcement agents and the Coast Guard could be aware of when a vessel was allowed to fish. Fishing times commonly began and ended in daylight hours, so that over-flights at dawn or dusk could determine that the dredge and other fishing gear was out of the water and the vessel was heading for port. The cost of such surveillance is high, so only a portion of the fishery could be monitored regularly. The flexibility of the vessel operator was constrained by the need to maintain uniform procedures.

Use of the 140 mm minimum size limit to control harvest of small surf clams has resulted in a significant increase in the amount of enforcement which can be done at the dock. Figures for enforcement show the marked increase in dockside enforcement actions after the minimum size measure was imposed in mid-1981 (Table 6).

Table 6

Enforcement caseload under the Surf Clam Management Programme, 1978-1982, by violation type

Year	Violations at Sea		Other violations	Total violations
	Vessel surveillance	Air surveillance		
1978	2	0	3	5
1979	2	10	9	21
1980	0	0	6	6
1981	1	9	47	57
1982	13	23	38	74
Total :	18	42	103	163

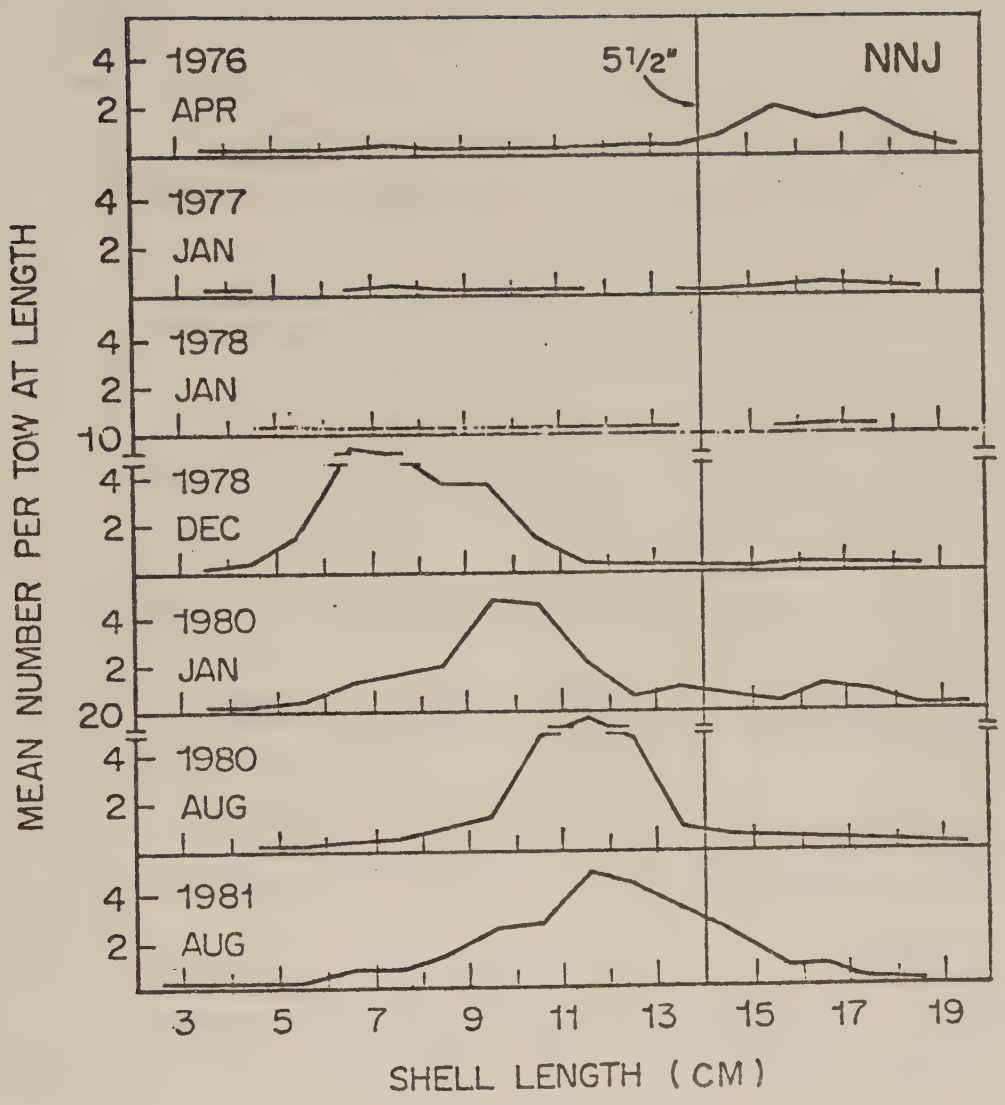
Source :
National Marine Fisheries Service Computer Case Tracking System

The present situation

This management programme has been in operation for over five years and appears to have served effectively to conserve the resource, and to have protected the significant recruitment represented by the 1976 and 1977 year classes of surf clams. Survey indices for the northern component of the resource off the New Jersey coast show that the resource there will reach, over the next two years, levels of relative abundance not seen since the initial exploitation of the fishery (Murawski, 1981). This abundance can be attributed primarily to the recruitment from the 1976 year class which settled in an area which had been extensively depleted of both surf clams and their predators by an anoxic condition [2/] that occurred throughout the New York Bight area in the late summer of 1976. The southern component of the resource, from Ocean City, Maryland southward to Cape Hatteras, North Carolina, benefitted from significant recruitment of the 1977 year class. An examination of the progression of the year classes through various size categories can be seen clearly in the size distribution figures produced using research survey vessel cruise information from the Northeast Fisheries Center in Woods Hole, Massachusetts (Figures 2 and 3). Significant quantities of these surf clams can be expected to reach commercial and legal size minimums between 1984 and 1985. In this southern division, the young clams cover an extensive geographical area.

All this expected recruitment could become an embarrassment of riches. Developing the initial conservation programme in the face of a crisis, to provide equitable access to a limited resource, was a difficult job. That job was made easier because the industry and the Council could both agree on the severity of the problem and on the need for immediate action. Converting the programme to one that can husband the resource at optimum levels on a permanent basis opens up a wide range of policy issues which are not easily resolved. Managers face a wider range of possible management options and the choice among the options must resolve competing philosophical and practical considerations.

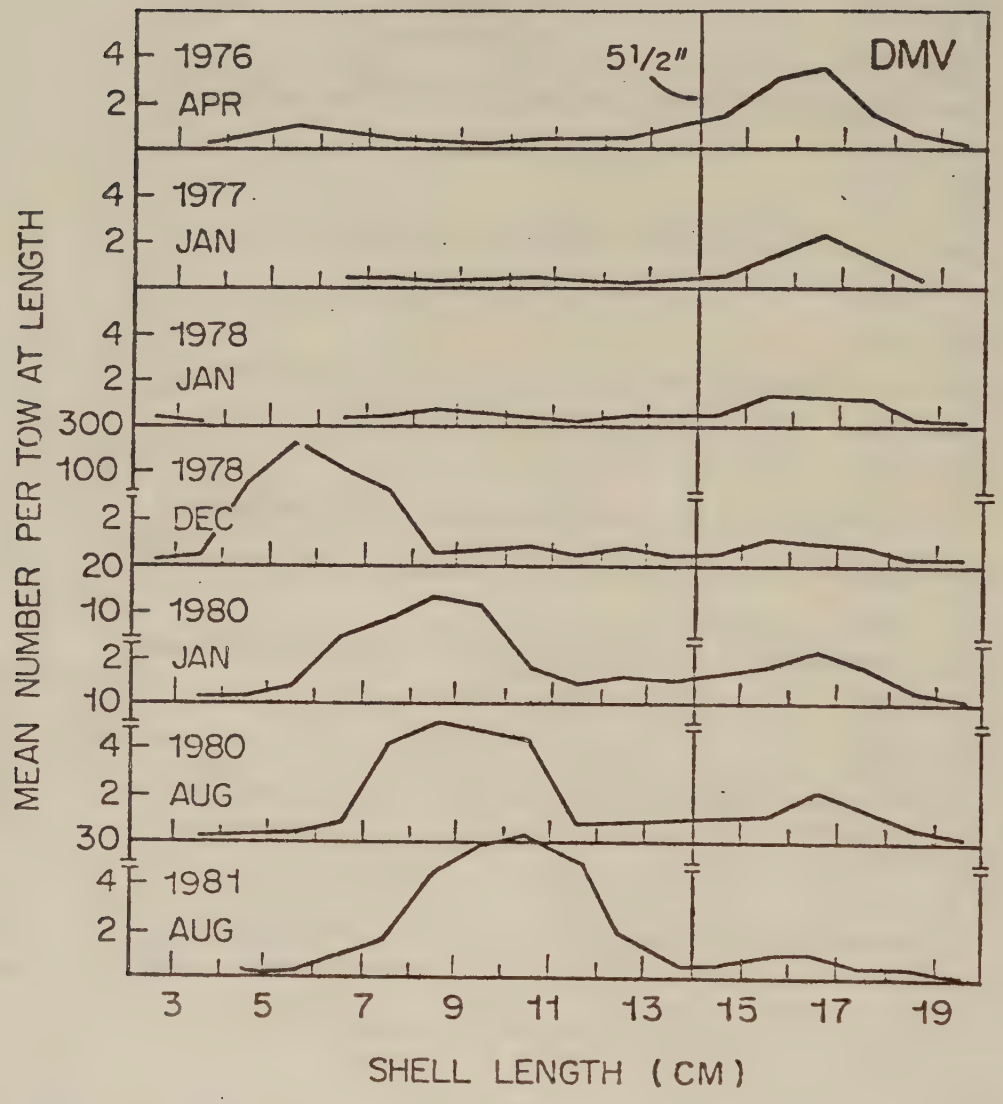
2/ The 1976 anoxic condition was a significant reduction in the amount of dissolved oxygen present in the water due to weather, hydrographic conditions, organic loading of the coastal waters and a bloom and die off of a dinoflagellate. The loss of surf clams was estimated at 147,000 tons of meat over a kill zone of 6,750 km^2, about 62 percent of the New Jersey resource (Ropes, 1980).



Source: Murawski, 1981.

Figure 2

Size distribution of surf clams off Northern New Jersey
Stratified mean numbers of surf clams per standardized tow, at length,
in NMFS Shellfish Surveys, 1976-1981



Source: Murawski, 1981.

Figure 3

Size distribution of surf clams off Delmarva Peninsula
Stratified mean numbers of surf clams per standardized tow, at length, in NMFS Shellfish Surveys, 1976-1981

Surf clams on the ocean bottom are essentially the same as funds on deposit in a bank. Natural mortality is relatively low, yield per recruit improves up to a size slightly below the minimum legal size and does not thereafter fall off dramatically. Heavy recruitment is sporadic and is not directly related to the abundance of adult surf clams. Long-term management at equilibrium levels requires the stock will not run out before the next episode of recruitment occurs. At times, fishermen will be aware that great stocks of clams are on the bottom but be forced to constrain their harvest to ensure that future catches will be available.

One of the most difficult problems currently faced is that the increasing abundance of the resource does not mitigate the problem of excess harvesting capacity in the fishery. The quota can only be increased if abundance increases but, as abundance increases, so does the catch per unit of effort. In a relative sense, the fisherman never improves his position because his market share never improves and his level of use of potential harvesting capacity remains very low. Projections of allowable fishing time as quotas are increased suggest that fishing time per vessel will remain at the present low level of 24 hours per week. If new recruitment continues to occur in beds where the clams are more densely distributed than in the fishery as a whole, fishing time will actually have to be reduced even as the resource abundance increases.

A long-term management philosophy for the surf clam fishery does not yet exist. Some observers, seeing the present increasing stock level as plentitude, suggest that the management programme has done its job and can be abandoned. This approach may be short-sighted, since all the factors which led to the initial need for management are still present or even exacerbated by a growing population of consumers, greater development of excess and under-utilized fishing capacity throughout the domestic fisheries and the dismal short-term outlook for other regional fisheries, such as Atlantic Sea scallops and groundfish.

The Fishery Management Councils and the National Marine Fisheries Service have not generally chosen to use the Magnuson Act to bring about long-term economic stability in the utilization of fisheries. This reluctance is displayed in explicit statements in several approved plans that economic issues have not been considered in formulating management strategies. This probably stems from the relative lack of experience in treating economic issues, the understandably prevalent view that regulatory action which adversely affects the economic performance of an industry is undesirable and a basic belief that regulation directed at solving specific economic problems usurps the generally superior role of the marketplace. A reasonable argument can be made, however, that any regulation designed to assess conservation needs of a resource will create economic inefficiency unless the regulation establishes property rights and vests the responsibility and ability to maximize efficiency with the individual harvestors.

Several of the management alternatives considered for the surf clam fishery are illustrative. A minimum harvest size for surf clams represents a direct and complete loss of income to the fisherman who would have directed his effort at smaller clams and, to a lesser degree, to the fisherman who must cull out small clams from his catch. The time and effort spent in culling and avoiding concentrations of small clams and the income lost when only small clams are available represent costs or imposed inefficiency.

A restriction on allowable fishing time represents a direct loss of the potential income from the time that cannot be spent fishing. The restriction may also have allocative effects. If all vessels receive by law the same amount of time to fish, vessels designed to have the ability to fish in adverse sea conditions will represent a wasted over-investment, while vessels which might only expect to fish in good weather receive a windfall.

Measures such as these, when used in combination, create a complex management programme designed to prevent the fisherman from taking what he could and would take under uncontrolled conditions. In essence, managers legislate inefficiency to address the fundamental management objective, which is to control harvest. This is the foundation of most fishery management programmes today. The more competent the fisherman, the more advanced the harvesting technique, the greater the impediments managers must design to prevent over-fishing. The problem is more serious when the control mechanisms designed by managers act indirectly. In the surf clam fishery under the present plan, managers determine each year, through the setting of the annual quota, how many surf clams may be taken. Actual regulation of harvest is divorced one step from this quota and is accomplished through the indirect linkage of restrictions on fishing time. The amount of fishing time allocated over the course of the year will result in varying harvests depending on the competence of the vessels, displayed as catch per hour fished, and on the weather and sea conditions during the hours chosen to fish. Fishing time must thus be monitored and adjusted continually, and each adjustment requires and represents a decision to allocate fishing opportunity, which translates into income, among various users.

The fisherman's response to each impediment is to change his operating strategy or invest in additional or re-designed equipment which might enable him to maintain or increase his harvest or market share. In the surf clam fishery, a significant number of vessels have been fitted with a second dredge to increase their hourly harvesting capacity, even though this increased harvesting capacity must in the end result in fewer available hours to fish for the fleet as a whole. Escalating over-capacity is the result. In the present surf clam fishery, capacity exceeds resource potential at maximum forseeable stock levels by perhaps two orders of magnitude. If fishing capacity could be rationalized to the level actually required to harvest available stocks with a normal five-day fishing week, only a dozen or less vessels of the size and configuration predominant in the fishery today would be needed. The difference between this number and the 123 vessels which in 1982 depended on the fishery for most of their income is an approximation of the current wasted capital, and of the economic surplus available to and from the fishery under a more efficient management system.

The current under-utilized manpower resources of the surf clam fleet are of a similar order of magnitude, although such resources do not now appear to be in urgent demand in other sectors of the economy. The effect of all this over-expenditure in harvesting capacity on the price of surf clams to consumers is substantial. Consumers must support, through increased prices for clam products, more than 100 unneeded vessels, with attendant costs for maintenance, labour, fuel and return on investment.

Options and outlook for the future

The following conclusions can be drawn from our five years' experience in management of the surf clam fishery:

(1) Quota management can be effective in ensuring a level of removals which will provide for preservation or enhancement of the level of a fishery stock.

(2) Quota management by itself will not likely provide for the social or economic stability necessary to maintain an effective resource management programme.

(3) As resource abundance increases, quotas become a less acceptable form of resource management, since they are seen to be less important to maintain the health of the resource.

(4) The transition in fishery management from a recovery mode to one of maintenance creates complex economic issues which then transcend the issue of resource conservation.

The Council is now in the process of developing a fourth amendment to the management plan to deal with the transition to a maintenance mode. The industry is generally very supportive of the concept of a vessel allocation for each operator expressed as some fraction of the overall quota. Most operators see this as a logical next step to reduce the number of management measures which would otherwise be needed and allow them more latitude to plan their fishing strategies.

The individual vessel allocation could be taken by the operator in any way, on whatever schedule he might chose. Some operators could take advantage of seasonal differences in meat yield of surf clams to maximize the final product yield of a given harvest. The fishing-time restrictions, area-closure procedures and even the minimum size limit, which today represent the greatest burden of management, might be eliminated. The rationale for eliminating the minimum size limit would be the expectation that each operator's desire to maximize his revenue from a given allocation would lead him to harvest large clams which have a higher value and greater yield of meat per bushel. This expectation could be proved wrong if an operator chose not to maximize his gross revenue from a fixed allocation but instead to maximize short-term income by harvesting his entire allocation in the form of very dense small clams over a short period of time.

The greatest advantage would come if allocations could be traded and combined, allowing operators to reach whatever level of operation and efficiency they need to be profitable. Vessels could be diverted to other fisheries after they take their allocation or could be tied up for extended periods, reducing insurance and other fixed costs. Operators might not take advantage of this opportunity and a vessel allocation programme might not result in a reduction in capitalization in the fishery. The programme would, however, create circumstances under which a reduction in capitalization could occur and leave the economic decisions to the individual operators. Operators who chose not to maximize profits would have only themselves to blame for their economic situation.

As with any allocation programme, the determination of initial shares is a most difficult problem. Allocations based on past performance do not satisfy those who feel they could have done better in the past without the restrictions which have been imposed. Operators who have not done well would like to see the initial allocation process used to redistribute income in their favour. Some operators have done very well under the competitive fishery which has developed by virtue of the existing management measures. Those operators want to continue to compete, expecting their market share will increase even further.

From the manager's perspective, a vessel allocation would allow for administration of the programme primarily at the dock, reducing enforcement costs. Management of the resource to attain optimum yield could become simple and direct. The indirect management linkage which now exists, because allowable harvests expressed as quotas are administered through conversion to fishing time, would be eliminated. The government would no longer be the arbiter of economic performance and profitability for the indsutry.

The industry and the Council have spent so much of their time over the last year studying vessel allocations that other management alternatives have not been seriously considered. The range of alternatives could include complete termination of the programme, use of a quota by itself or in conjunction with a minimum size limit or some form of more complex economic management. A complex scheme might establish a minimum return on investment. If that rate of return were not met for the fleet, then the least profitable vessels would be eliminated from the fishery until the desired level of profitability was reached. A variant of this alternative would set a minimum annual harvest level, and any vessel which failed to reach that level would be eliminated from the fishery.

The final outcome of the Council's deliberations is at the moment very much an open question.

References

Mid-Atlantic Fishery Management Council, 1977 Fishery Management Plan for surf clam and ocean quahog fisheries

_____, 1979 Amendment No.1 for the Surf Clam and Ocean Quahog Fishery Management Plan

_____, 1979a Amendment No.2 for the Surf Clam and Ocean Quahog Fishery Management Plan

_____, 1981 Amendment No.3 for the Fishery Management Plan for the Atlantic Surf Clam and Ocean-Quahog Fisheries

_____, 1982 Review of the Surf Clam and Ocean Quahog Fishery Management Plan

Murawski, S.A., 1981 Assessment and current status of offshore surf clam, Spisula solidissima, populations off the middle Atlantic coast of the United States. Woods Hole Lab.Ref.Doc.,(81-33)

Parker, P.S., 1971 History and development of surf clam harvesting gear. NOAA Tech.Rep.NMFS Circ., (364)

Rinaldo, R.G., 1977 Draft environmental impact statement for the implementation of a fishery management plan for the surf clam and Ocean quahog fisheries

Ropes, J.W., 1980 Biological and fisheries data on surf clam, Spisula solidissima. Woods Hole Lab.Doc. Tech.Ser.Rep., (24)

_____, 1982 The Atlantic coast surf clam fishery, 1965-1974. Mar.Fish.Rev., 44(8):13 p.

THE HISTORY AND EVALUATION OF CLOSURE REGULATIONS IN THE PACIFIC HALIBUT FISHERY

by

Bernard Einar Skud
National Marine Fisheries Service
Narragansett, Rhode Island, USA

INTRODUCTION

The history of seasonal and areal closures as conservation measures dates back to the 1800s. In Europe, perhaps the earliest attempt to evaluate the effects of an area closure was an experiment conducted under the auspices of the Scottish Fishery Board from 1886 to 1896 (Garstang, 1900). In North America, the US Congress passed the Alaskan Salmon Law in 1896, which introduced closed areas in spawning streams and prohibited fishing in the evenings and on weekends (Moser, 1899). Among marine species, the management of the fishery for Pacific halibut (Hippoglossus stenolepis) has probably had the most extensive and continued use of closures which, along with its other regulations, have attracted the attention of biologists and economists alike (Graham, 1935; Nesbit, 1943; Burkenroad, 1948; Gordon, 1954; Scott, 1955; Beverton and Holt, 1957; Crutchfield and Zellner, 1962; Bell, 1970; Skud, 1975; and many others). One of the reasons for this attention is ensconced in the most creditable feature of the International Pacific Halibut Commission (IPHC) - that of collecting and maintaining detailed statistics on the fishery since the 1920s. It is this forte and the resultant records that enabled scientists to scrutinize the management of the halibut fishery and permits the 60-year examination of the effectiveness of closure regulations in this paper. I will review the history of the closures and the evaluations of their biological and economic impacts.

REGULATORY AUTHORITY

When IPHC was created in 1923 and given the responsibility to regulate the Canadian and United States fishery for Pacific halibut, the Commission's authority was limited to two regulations (Bell, 1969). These regulatory measures provided for a closed season and for controls on the incidental catch (by-catch) of halibut in fisheries for other species. The Convention of 1930 broadened the regulatory authority and allowed the Commission to establish catch limits by regulatory areas, prohibit fishing on nursery grounds, specify the gear used in the fishery, extend the closed season and introduce a licensing scheme. Revisions of the Convention in 1937 and 1950 provided IPHC with greater flexibility in the management of the fishery. The major changes in regulations concerning closures were designed to permit more than one fishing period each year, i.e. "establish one or more open or closed season" and "close to all taking of halibut such portion or portions of an area or areas ... populated by small, immature halibut ..."

SEASONAL CLOSURES

The Convention of 1923 set the fishing season from 16 February to 15 November. In 1932, the 16 February opening data was maintained but the closing date was dependent on the attainment of a catch quota, except that if the quota was not reached the season would end on 31 October. This statutory closing date has been changed over the years and in the 1970s was as early as 8 September.

Although the initial provision for a closed season established the base for subsequent regulatory measures, it failed to reduce fishing effort and, by itself, was considered to be of limited conservation value (Babcock et al., 1931; Bell, 1969). The closed season during the winter had been introduced before the existence of IPHC and conservation, per se, was only an incidental consideration in its implementation (Thompson and Freeman, 1930; IFC, 1948). The Commission's decision to retain the closed season was based primarily on economic factors (Babcock et al., 1931).

"The Commission is, however, satisfied that the adoption of the closed season was a wise measure, as it has obvious beneficial economic effects as far as the whole fishery is concerned. It eliminates the most expensive fishing part of the year, and one which is also full of hardship. It stabilizes the price of frozen halibut, and this in turn has a favourable effect on the demand for such frozen fish. The catches at that time of year are claimed to be of poor quality, and frequently so great as to lower the selling price below what is profitable. On account of these conditions all branches of the industry and the Commission are unanimous in their support of maintaining the closed season."

Biological justifications for the closed seasons were noted many years later. Dunlop (1959) stated that, while the benefits of the closed season might continue to be largely economic, "... it would also help to maintain spawning reserves. In the absence of knowledge regarding the size of stock required to obtain maximum recruitment, concentration of fishing upon the matures when they were highly segregated and vulnerable upon the spawning grounds was not justified. They were already being heavily exploited upon the summer feeding grounds."

The opening date and the length of the season for the two major producing areas provide an overview of the changes in the fishing time and the season (Table 1). The opening date of the fishery changed more frequently than any other IPHC regulation and often was the subject of controversy among fishermen from different geographic areas, between fishermen and processors and between part-time and full-time fishermen (Skud, 1977). Industry preferences for early and late openings were based on economic considerations. For example, part-time fishermen generally favoured an early opening so that they could participate in the halibut fishery as long as possible before the start of the salmon fishery. Other reasons also were of concern, in particular the tides, because certain areas could not be fished on spring tides and fishermen wanted to avoid these periods as opening dates.

During the 1940s, the catch quotas were attained progressively earlier and the length of the fishing season decreased. The distribution of fishing effort changed and the Commission expressed concern that certain stocks were being "under-utilized" and that others were being "over-utilized" (IFC, 1951). Because the existing Convention did not permit a division of the fishing season into two or more periods, the Commission sought other means of redistributing fishing effort. One of the methods proposed was to rotate the opening date between early and mid-May from the late 1940s to the 1960s (Table 1).

During the 1950s, IPHC decided "... that management must be modified to deal with each component stock according to its individual need ..." and, in 1951-1953, established separate sections which were opened to fishing after the regulatory area was closed (IPHC, 1961). This approach changed in 1954, after the ratification of the new Convention that provided for multiple open seasons. The regular fishing season (with a catch limit) was supplemented by a short season (without a catch limit) "to obtain fishing on grounds and segments of the stocks not utilized during the regular season" (IPHC, 1961). By 1961, in part because of the industry's voluntary "lay-up programme" (described later), the length of the regular season had increased and the need for the additional season was eliminated (IPHC, 1962).

In the 1970s and 1980s, fishing effort increased markedly. The number of licensed vessels (5 net tons or more) increased from 497 in 1975 to 1,204 in 1977 and, in 1981, was 1,462. In addition, there were between 2,000 and 4,000 vessels under 5 net tons which were not licensed by IPHC. Although most of these vessels participated in other fisheries, this increase in effort resulted in an early attainment of the catch quota and the seasonal closure of the fishery occurred earlier each year. To prevent excessive fishing mortality on the "early component" of the stock, IPHC in 1976 introduced a system of successive openings and closures to distribute the effort during different months of the fishing season.

Until the late 1950s, the season in the Bering Sea coincided with that in the Gulf of Alaska. By the early 1960s, the opening in the Bering Sea often was a month earlier than in the Gulf. The earlier opening was established to encourage fishermen to exploit the Bering Sea stocks. Since 1965, the fishing time has been limited to three weeks or less in the spring or fall or both. This curtailment was necessary because of the drastic decline in the abundance of the Bering Sea stock of halibut. The main purpose of allowing any fishery to continue after 1965 was to gather information for stock assessment.

Table 1. Opening and Closing Dates and Length of the Halibut Fishing Season, 1932-1976 in Areas 2 and 3[1]/

Year	AREA 2			AREA 3A		
	Opening date	Closing date	Length of Season [2]/	Opening date	Closing date	Length of Season [2]/
	Month/Day	Month/Day	Days	Month/Day	Month/Day	Days
1932	2-16	10-22	250	2-16	10-30	259
1933	2-01	8-25	206	2-01	10-26	268
1934	3-01	8-19	172	3-01	10-27	241
1935	3-01	9-06	159	3-01	12-26	270
1936	3-16	8-10	148	3-16	11-03	233
1937	3-16	7-28	135	3-16	10-19	218
1938	4-01	7-29	120	4-01	10-29	212
1939	4-01	7-29	120	4-01	10-28	211
1940	4-01	7-13	104	4-01	9-26	179
1941	4-01	6-30	91	4-01	9-14	167
1942	4-16	6-29	75	4-16	9-25	163
1943	4-16	6-20	66	4-16	9-08	146
1944	4-16	7-09	51	4-16	11-30	195
1945	5-01	6-15	46	5-01	9-24	147
1946	5-01	6-11	42	5-01	8-19	111
1947	5-01	6-08	39	5-01	8-17	109
1948	5-01	6-01	32	5-01	7-11	72
1949	5-01	6-03	34	5-01	7-12	73
1950	5-01	6-01	32	5-01	7-05	66
1951	5-01	5-28	38	5-01	6-25	56
1952	5-14	6-08	36	5-14	7-12	60
1953	5-17	6-09	34	5-17	7-07	52
1954	5-16	6-05	29	5-16	7-12	68
1955	5-12	6-05	31	5-12	8-04	93
1956	5-12	6-27	45	5-12	8-24	105
1957	5-01	6-17	54	5-01	9-22	144
1958	5-04	7-02	66	5-04	8-31	119
1959	5-01	7-08	75	5-01	8-01	92
1960	5-01	7-31	98	5-01	7-25	85
1961	5-10	9-07	120	5-10	8-23	105
1962	5-09	9-08	122	5-09	8-11	94
1963	5-09	11-30	205	5-09	8-09	92
1964	5-01	9-15	137	5-01	8-19	110
1965	5-01	9-15	137	5-01	8-26	117
1966	5-09	8-25	108	5-09	8-15	98
1967	5-09	10-15	159	5-09	10-15	159
1968	5-04	10-15	164	5-04	10-15	164
1969	5-07	9-21	137	5-07	9-22	138
1970	4-25	9-21	149	4-25	9-21	149
1971	5-07	11-01	178	5-07	11-01	178
1972	5-01	8-10	101	5-01	9-14	136
1973	5-10	8-13	95	5-10	10-01	144
1974	5-17	9-15	121	5-17	9-15	121
1975	5-01	9-06	128	5-01	9-06	128
1976	5-08	9-08	123	5-08	8-12	96
1977 [3]/	5-10	9-10	73	5-10	7-30	47
1978 [3]/	5-15	9-13	62	5-15	8-4	43
1979 [3]/	5-25	8-5	47	5-25	7-12	32
1980 [3]/	5-20	5-30	10	5-19	7-19	20
1981 [3]/	6-7	9-19	56	6-7	6-20	13

1/ Area 2 includes all waters of southeastern Alaska, British Columbia, Washington, Oregon and California (see footnote 3). Area 3A includes the waters of the Gulf of Alaska from southeastern Alaska to the Alaskan Peninsula.

2/ In 1935, and 1956, the fleet did not begin fishing on the opening date because of externalities such as price disputes. These non-fishing periods are excluded from the length of the season. In Area 3 from 1954 to 1956, the number of fishing days includes special seasons of 9 to 10 days.

3/ Split-season, i.e. series of open and closed periods. In 1980, Area 2 was divided into sub-areas; 2A was southeastern Alaska, 2B was British Columbia and 2C was all waters south of British Columbia. The data for 1980 and 1981 is only for Area 2A.

The spring and fall fishing periods usually occur before and after the regular season in the Gulf of Alaska, when vessels are most likely to fish in the Bering Sea. Further, halibut are more densely concentrated during these periods. Since 1963, IPHC's recommendations for regulations in the Bering Sea have been reviewed and approved by the International North Pacific Fisheries Commission (INPFC). Closures on Japanese and Soviet fisheries were also introduced in the Bering Sea and are discussed under the section on closed areas.

VOLUNTARY CLOSURES BY THE INDUSTRY

In addition to IPHC's regulations, the fishing industry periodically introduced controls that affected the length of the fishing season and the distribution of the catch (Skud, 1977a). During the 1930s, the organized fishermen (union members) introduced a programme that required each vessel to lay-up for 10 days between trips. The lay-up programme continued with periodic modifications until World War II, when military officials concerned for the safety of men and vessels urged that the fishery be conducted in as brief a period as possible.

During the early 1950s, competition among halibut fishermen was so keen that the catch limit was taken in less than two months. Fishermen had no rest periods between trips and the processors occasionally had difficulty handling the volume of the catch. In 1956, organized fishermen in Canada and the United States re-instituted the lay-up programme to extend the fishing season, establish rest periods for the fishermen, attain a more orderly delivery of the catch, and aid in the conservation of the resource. The programme was supported by 18 organizations (unions and vessel-owner associations) whose representatives met annually to establish the lay-up rules. Eventually, the rules applied to four types of vessels and governed their fishing activity. Vessels and crew members could not engage in other fisheries during their lay-up and running time to ports of landing could not be deducted from the lay-up time. Each participating vessel had a crew delegate who was responsible for reporting arrivals and departures from port. The success of the lay-up programme is evidenced by the gradual increase in the length of the season during the late 1950s and 1960s (Table 1); however, part of this increase is also due to the decline in the abundance of halibut during this period.

Support for the lay-up programme was strong among the full-time halibut fishermen but part-time and non-union fishermen did not always comply with the rules. IPHC was asked to incorporate the lay-up programme in its regulations to insure compliance. Although IPHC supported the concept of the lay-up programme from the conservation standpoint, legal advisors in both governments concluded that the Commission did not have the authority, under the existing Convention, to regulate departures of individual vessels (Skud, 1977b).

During the 1970s, many new and part-time fishermen, who either were unaware of the objectives of the lay-up plan or disagreed with the rules, did not comply with the lay-up system. As a result, the support of the full-time halibut fishermen waned and the lay-up programme was in jeopardy for several years. In 1977, the Fishermen's Lay-Up Review Committee announced that the programme was being discontinued because it lacked the needed support. With the diversity of vessels in the fleet, the possibility of devising a lay-up programme that would satisfy everyone was remote. Legal interpretation aside, IPHC decided it could not adopt the lay-up plan because neither country had the manpower or funds to adequately enforce the lay-up rules.

With the lapse of the voluntary lay-up programme, IPHC had the option of letting the fishing season run its natural course and end within 50 days or of splitting the season so that fishing would be extended over a longer period. A short, single-season would have concentrated the fishing effort and resulted in excessive mortality on certain components of the stock. There also was concern that the cold storage facilities would not be adequate to handle the landings when concentrated in a short period of time. The Commission decided that the fishing season should be divided into open and closed periods to extend the fishing time and spread the fishing mortality between early and late components of the stock. In adopting this split-season plan, the Commission attempted to provide for an overall fishing season similar in length to that of 1976. Four fishing periods were established in consort with industry preferences: (1) 10-29 May, (2) 16 June to 4 July, (3) 20 July to 7 August, and (4) 23 August to 10 September. As in the past, the season in each regulatory area would be closed when the catch limit was attained, regardless of the designated fishing periods. Although the dates and length of the periods have changed, this system is still employed in today's fishery (IPHC, 1982).

CLOSED AREAS

In 1932, a year-round closure of halibut fishing was established in two "nursery areas" to protect young halibut. One of these areas was in south-eastern Alaska and the other was in British Columbia. These closures were retained until 1960, when the areas were opened to fishing during the regular season. Studies during the late 1950s had shown an "accumulation of old and large fish" in these nursery areas which "do not currently qualify for closure as nursery grounds under the provisions of the Convention" (IPHC, 1960). In 1967, an area in the south-eastern Bering Sea was declared a nursery area and a year-round closure was instituted that still is in effect.

Although not a part of IPHC regulations, certain areas were closed to domestic (Canadian and US) and foreign (Japanese and Soviet) trawlers, to reduce the incidental catch of halibut. These closures were established even though IPHC has no authority to regulate domestic fishing for species other than halibut and has no control over foreign vessels. Bell (1970), Skud (1973), Hoag and Skud (1975), and Hoag (1976) described the effects of Japanese and Soviet trawl fisheries on the North American longline fishery. Although targeting on other species, e.g. pollock (Theragra chalcogrammus) and yellowfin sole (Limanda aspera), the foreign fleets annually caught millions of pounds of halibut. Data collected by observers aboard the foreign vessels showed that most of the halibut were from 3 to 7 years old, below the minimum size permitted in the longline fishery, and that this incidental catch substantially reduced the recruitment and potential yield in the Canadian and US fisheries.

Realizing the importance of these productive trawl fisheries and recognizing that foreign trawling would be likely to continue, even if national fishery zones were extended, IPHC studied ways to reduce the incidental catch of halibut while still maintaining the production of the trawl fisheries. The data from the observer surveys showed that the incidental catch of halibut differed by area, depth and season. These results conformed with the known areal and depth distribution of halibut, which generally are in depths over 200 m during the winter and in depths less than 100 m during the summer. In 1973 IPHC proposed regulations to close trawling in areas where halibut congregated in the winter and to allow unrestricted fishing in the summer, when halibut moved to the shoaler waters of the continental shelf. Japan agreed to some of the closures in 1974 and agreed to additional closures in 1975. The USSR agreed to similar closures in 1976. The estimated incidental catch of halibut was reduced as anticipated. Although the closures resulted in a reduction of trawling effort, by reducing the fishing from year-round to less than 9 months, the CPUE of the trawlers increased and the level of Japanese and Soviet catch of pollock in the Bering Sea increased during 1976 and 1977.

EVALUATION OF CLOSURES IN THE HALIBUT FISHERY

My intent in this discussion is not to evaluate specific goals of closure regulations, rather I shall consider the general problem of instituting conservation measures for biological reasons and the resultant (often conflicting) economic effects.

IPHC gained international recognition for revitalizing the halibut fishery between 1930 and 1960 and the restoration of the stock is still considered "strikingly successful" , even though some scientists (Burkenroad, 1948; Ketchen, 1956; Fukuda, 1962) questioned IPHC's role in the recovery of the stock, and Skud (1972, 1975) and Hamley and Skud (1978) showed that assessment of stock abundance had to be revised. The most severe criticism of IPHC came from economists (Nesbit, 1943; Gordon, 1954; Crutchfield and Zellner, 1962; and many others) who claimed that the regulations reduced the economic efficiency of the fishery. Bell and Pruter (1958) and Bell (1959, 1970, 1981) repudiated all of the biological and economic criticisms. The past and current economic arguments - pro and con - generally concentrate on the period before 1960 and were not specifically concerned with closure regulations. My attempt to evaluate the effects of closures in this paper is thwarted by the inter-related effects of other regulations and by determination of whether effectiveness is judged in biological or economic terms. However, I do think that the regulatory experience in the halibut fishery can be informative and useful, especially with the inclusion of events after 1960.

Under IPHC management, from 1923 to 1979, Canadian and United States halibut vessels fished simultaneously in waters off four States and one Province under a uniform set of regulations. 1/ This fact and the maintenance of a viable fishery during this period, in themselves are measures of successful management. Further, through the introduction of different types of regulation and the study of their effects, IPHC has also contributed in a substantial way to the fields of fishery science

and biological management. That economic difficulties have and still exist in the halibut fishery does detract from IPHC's biological achievements but the experience of this fishery probably has contributed more than any other single fishery to the theory and practice of economic management. Part of the difficulty experienced by IPHC was that its management authority did not include economic considerations, even though the sponsoring national governments fostered more progressive goals (Skud, 1977b). As pointed out by Needler (1973) and Alversen and Paulik (1973), conservation bodies are often hindered by the restriction of their own conventions, and Johnson's (1973) summary is particularly applicably to IPHC:

> "The Commissions have encountered economic and political problems which their limited authority prevents them from confronting (e.g. over-entry into the fishery). In some cases, the success of a Commission in restoring a fishery actually creates such problems by attracting new entrants. Thus, the Commissions may fulfill their legal biological goal yet become economic and political failures in the process. Several observers have pointed out that setting out rigid legal definitions of what commissions can or cannot do has been an impediment to their growth, by preventing their adjustment to conditions they have by their existence created."

Thus, the evaluation of closures or any other regulations should include consideration of the governing agency's authority to manage the fishery.

Crutchfield and Zellner (1962) made the following generalization concerning closures:

> "... Restrictions on fishing time may be ineffective ... if they simply shift pressure to the open season. To the extent that they do restrict the catch, they are likely to decrease overall industry efficiency unless vessels, gear and shore facilities can be shifted, without loss, to other uses during the closure periods."

In the halibut fishery the shore facilities always have served other fisheries (salmon, herring, etc.) and the effect of the seasonal closures on these facilities was far less than on the fishermen (vessels and gear). Before effort became excessive, the seasonal and area closures did contribute toward the attainment of specified biological goals without seriously affecting the economic efficiency of the halibut fishery. As effort increased and the fishing time decreased well below 100 days in the 1950s, biological goals were jeopardized, the economic efficiency of operation was impaired and other problems such as the safety of the fishermen increased markedly. These conditions were ameliorated in the 1960s and early 1970s when fishing time increased, on average, to 150 days.

In the late 1970s and particularly in the 1980s, effort again increased and the severity of the resultant problems, in some respects, have eclipsed those of the 1950s. Many factors, including the declining fortunes in other fisheries, contributed to this latest increase in effort in the halibut fishery. One factor that had a marked effect was the very attempt of regulatory agencies to cope with the problem since 1980, i.e. as agencies considered limited entry as a means to remedy the situation, fishermen in other fisheries entered the halibut fishery to establish priorities (meet criteria) that would be needed for licensing under the pending limited entry programme. Indeed, part of the increase in effort during the 1970s was the direct result of introducing limited entry programmes in the salmon fisheries of Alaska and British Columbia, i.e. fishermen anticipated similar action in the halibut fishery. In this regard, the lesson is simple: introduction of limited entry should consider limitations for <u>all</u> fisheries in a given jurisdiction to prevent the leap-frogging effect of solving the problem of excessive effort in one fishery only to create the same problem in another fishery.

From the experience in the halibut fishery with seasonal and area closures, it is possible to classify regulations in a hierarchy of importance, i.e. those regulatory measures that are most effective in controlling effort are more critical than measures concerned with gear, protection of young, etc. However, measures such as limited entry, alone, will not ensure successful management. In the halibut fishery - even with its dis-economies - the catch limit or quota (and its attendant closures) has been the regulatory measure with the greatest impact. Without the quota, the present-day effort probably would have led to the inevitable depletion predicted by economist's models of uncontrolled fisheries. However, the quota alone will not prevent economic inefficiencies. In other fisheries - for example, anadromous species - there is a different hierarchy, i.e. a seasonal closure, which assures the escapement of an adequate spawning stock can ensure the perpetuation of the stock but may also be fraught with economic difficulties unless fishing effort is controlled.

LITERATURE CITED

Alverson, D.L. and G.J. Paulik, Objectives and problems of managing aquatic living resources.
1973 J.Fish.Res.Board Can., 30(12)Pt.2:1936-47

Babcock, J.P. et al., Report of the International Fisheries Commission appointed under the Northern
1931 Pacific Halibut Treaty. Rep.Int.Fish.Comm., (1):31 p.

Bell, F.H., Economic effects of regulation of the Pacific halibut fishery. In Biological and economic
1959 aspects of fisheries management, edited by J.A. Crutchfield. Seattle, University of Washington, pp.51-75

————, Agreements, conventions and treaties between Canada and the United States of America
1969 with respect to the Pacific halibut fishery. Rep.Int.Pac.Halibut Comm., (50):102 p.

————, Management of Pacific halibut. In A century of fisheries in North America, edited by
1970 N.G. Benson. Spec.Publ.Am.Fish.Soc., (7):209-21

————, The Pacific halibut: the resource and the fishery. Anchorage, Alaska, Alaska Northwest
1981 Publishing Co., 267 p.

Bell, F.H. and A.T. Pruter, Climatic temperature changes and commercial yields of some marine
1958 fisheries. J.Fish.Res.Board Can., 15(4):625-83

Beverton, R.J.H. and S.J. Holt, On the dynamics of exploited fish populations.
1957 Fish.Invest.Minist.Agric.Fish.Food G.B.(2 Sea Fish.), 19:533 p.

Burkenroad, M.D., Fluctuations in abundance of Pacific halibut. Bull.Bingham Oceanogr.Coll.,
1948 11(4):81-129

Crutchfield, J. and A. Zellner, Economic aspects of the Pacific halibut fishery. Fish.Ind.Res.,
1962 1(11):173 p.

Dunlop, H.A., Management practices in the Pacific halibut fishery and their relation to the biology of
1959 conservation. In Biological and economic aspects of fisheries management, edited by J.A. Crutchfield. Seattle, University of Washington, pp.41-9

Fukuda, Y., On the stocks of halibut and their fisheries in the northeastern Pacific. Bull.INPFC,
1962 (7):39-50

Garstang, W., The impoverishment of the sea. A critical summary of the experimental and statistical
1900 evidences bearing upon the alleged depletion of trawling grounds. J.Mar.Biol.Assoc.U.K., 6:1-69

Gordon, H.S., The economic theory of a common property source: the fishery. J.Polit.Econ., 62:124-42
1954

Graham, M., Review of: W.F. Thompson and F.H. Bell, "Biological statistics of the Pacific halibut
1935 fishery". J.Cons.CIEM, 10(2):210

Hamley, J.M. and B.E. Skud, Factors affecting longline catch and effort. 2. Hook-spacing.
1978 Sci.Rep.IPHC, (64):16-24

Hoag, S.H., The effect of trawling on the setline fishery for halibut. Sci.Rep.IPHC,(61):20 p.
1976

Hoag, S.H. and B.E. Skud, Effect of multi-species fisheries on the management of halibut stocks. FAO
1975 Fish.Rep., (171)Suppl.1:27-35

IFC(International Fisheries Commission), Regulation and investigation of the Pacific halibut fishery in
1948 1947. Rep.Int.Fish.Comm.,(13):35 p.

————, Regulation and investigation of the Pacific halibut fishery in 1949.
1951 Rep.Int.Fish.Comm.,(15):24 p.

IPHC (International Pacific Halibut Commission), Regulation and investigation of the Pacific halibut
1960 fishery in 1959. Rep.IPHC, (29):17 p.

————, Regulation and investigation of the Pacific halibut fishery in 1960. Rep.IPHC, (30):24 p.
1961

————, Regulation and investigation of the Pacific halibut fishery in 1961. Rep.IPHC,(32):23 p.
1962

————, Annual report, 1981. Annu.Rep.IPHC,(1981):48 p.
1982

Johnson, E.B., The regulation of international fisheries. Ph.D.Diss. University of Washington, Seattle,
1973 213 p.

Ketchen, K.S., Climatic trends and fluctuations in yield of marine fisheries in the Northeast Pacific.
1956 J.Fish.Res.Board Can., 13(3):357-74

Moser, J.F., The salmon and salmon fisheries of Alaska. Bull.U.S.Comm.Fish., (1898):178 p.
1899

Needler, A.W.H., Chairman's summary of the highlights of the conference. J.Fish.Res.Board Can.,
1973 30(12)Pt.2:2508-11

Nesbit, R.A., Biological and economic problems of fishery management. Spec.Sci.Rep.U.S.Fish
1943 Wildl.Serv., (18):23-53

Scott, A.D., The fishery: the objective of sole ownership. J.Polit.Econ., 63:116-24
1955

Skud, B.E., A reassessment of effort in the halibut fishery. Sci.Rep.IPHC, (54):11 p.
1972

————, Management of the Pacific halibut fishery. J.Fish.Res.Board Can., 30(12)Pt.2:2393-8
1973

————, Revised estimates of halibut abundance and the Thompson-Burkenroad debate.
1975 Sci.Rep.IPHC, (56):36 p.

————, Regulations of the Pacific halibut fishery, 1924-1976. Tech.Rep.IPHC, (15):47 p.
1977

————, Lay-up program in jeopardy, some fishermen to abstain. West.Fish., 93(5):13-32
1977a

————, Jurisdictional and administrative limitations affecting management of the halibut fishery.
1977b Ocean Dev.Int.Law J., 4(2):121-42

Thompson, W.F. and F.H. Bell, Biological statistics of the Pacific halibut fishery. 2. Effect of changes
1934 in intensity upon total yield and yield per unit of gear. Rep.Int.Fish.Comm., (8):49 p.

Thompson, W.F. and N.L. Freeman, History of the Pacific halibut fishery. Rep.Int.Fish.Comm.,(5):61p.
1930

THE MANAGEMENT OF CHILEAN PELAGIC FISHERIES WITH EMPHASIS ON THE SPANISH SARDINE (Sardinops sagax musica)

by

Alejandro Zuleta and Juan R. Serra
Undersecretariats of Fisheries
Teatinos 120
Santiago, Chile

1. INTRODUCTION

Pelagic fisheries are the main type of fisheries that have been developed in Chile. They represent over 80 percent of national landings of marine products at present, with exports of fish meal and oil standing at close to two hundred and fifty million dollars, and therefore are one of the country's most important export activities.

The impressive increase in landings by more than five times since 1973 is the result of a substantial increase in two resources: Spanish sardine (Sardinops sagax), and jurel (Trachurus murphyi), which were caught in insignificant amounts at the end of the sixties. Up to 1978, the increase in the catch from these resources, plus smaller amounts of other species, provided raw material for the industry which had been left with considerable idle capacity by the anchovy (Engraulis ringens) crisis.

Since 1978, and as a result of the boom in fisheries, a new investment process was started which represents an important increase in catching and processing capacity. However, as at the beginning of the decade of the sixties, the new investments were not based on knowledge of the long-term productive possibilities of the resource but rather on its unexpected and fortunate increase.

To manage these fisheries adequately, consideration should be given to their fluctuating nature. This aspect has not always been recognized by the agencies responsible for their management. This paper includes a description of these fisheries and the actions and problems involved in managing them.

2. DESCRIPTION OF CHILE'S PELAGIC FISHERIES

Chile's pelagic fisheries are located within a system of currents along the eastern border of the Southern Pacific Ocean (Fig. 1). The area includes the following three fisheries units:

Northern zone	:	from border with Peru - 25- Lat.S.
Coquimbo	:	20-15' Lat.S. - 30-15' Lat.S.
Talcahuano	:	36-10' Lat.S. - 37-10' Lat.S.

The following species are involved: anchovy (Engraulis ringens), horse mackerel (Scomber japonicus peruanus), jurel (Trachurus murphyi), common sardine (Clupea (strangomera) bentincki), and Spanish sardine (Sardinops sagax musica). With the exception of the common sardine, which is only caught in Talcahuano, the remaining species are present in the three fisheries units in a greater or lesser degree (Table 1). The northern zone is the most important fisheries unit because of the quantity of landings and installed industrial capacity. In 1981, landings amounted to 2,159,341 tons, which represented 70 percent of the country's total catch. The other fisheries units caught 51,000 and 492,000 tons, respectively. This paper will refer to fisheries in the northern zone, mainly Spanish sardine, which is the system's dominant species.

Table 1. Landings by Species of the Chilean Pelagic Industrial Fishery

		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Northern Zone (Arica-Antofagasta)													
	Jack mackerel	175.003	184.993	62.886	71.392	163.392	186.890	237.876	225.907	365.265	331.265	284.272	435.061
	Spanish sardine	13.891	24.820	10.831	50.894	169.278	134.278	280.287	551.680	687.815	1.429.924	1.592.395	1.425.499
	Mackerel	-	8.466	1.017	3.808	215	15.235	52.712	138.215	171.238	39.574	101.967	98.964
	Anchovy	624.444	790.579	283.770	142.543	328.715	197.360	389.356	10.168	191.981	45.377	99.382	199.817
	Total	813.338	1.008.858	358.504	268.997	661.600	533.763	960.231	925.970	1.416.299	1.846.064	2.078.016	2.159.341
Coquimbo													
	Jack mackerel	3.222	5.296	5.736	3.874	5.222	7.302	10.606	2.850	4.798	20.030	23.976	24.739
	Spanish sardine	-	31	1.422	6.572	15.179	22.471	31.268	34.845	36.303	51.499	38.986	25.601
	Mackerel	-	-	9	12	5	23	47	222	1.700	748	2.341	380
	Total	3.222	5.327	7.167	10.426	20.406	29.796	41.921	37.917	42.801	72.277	65.303	50.720
Talcahuano													
	Jack mackerel	8.143	1.779	1.364	5.030	7.456	27.649	54.964	72.735	144.539	183.008	191.422	406.212
	Spanish sardine	-	-	-	-	1.670	-	-	386	1.570	37.068	72.325	86.226
	Mackerel	-	-	-	-	-	-	-	332	-	-	-	-
	Common sardine + Anchovy	76.255	197.411	141.575	144.077	164.127	47.214	6.592	12.967	5.915	14.910	3.600	-
	Total	84.398	199.190	142.939	149.107	173.253	74.863	61.556	86.420	152.024	234.986	267.347	492.438
	TOTAL	900.948	1.213.375	508.610	428.562	855.259	638.422	1.063.708	1.050.307	1.611.124	2.153.327	2.410.666	2.702.499

Source: IFOP

Figure 1

Geographical location of the Chilean pelagic fisheries

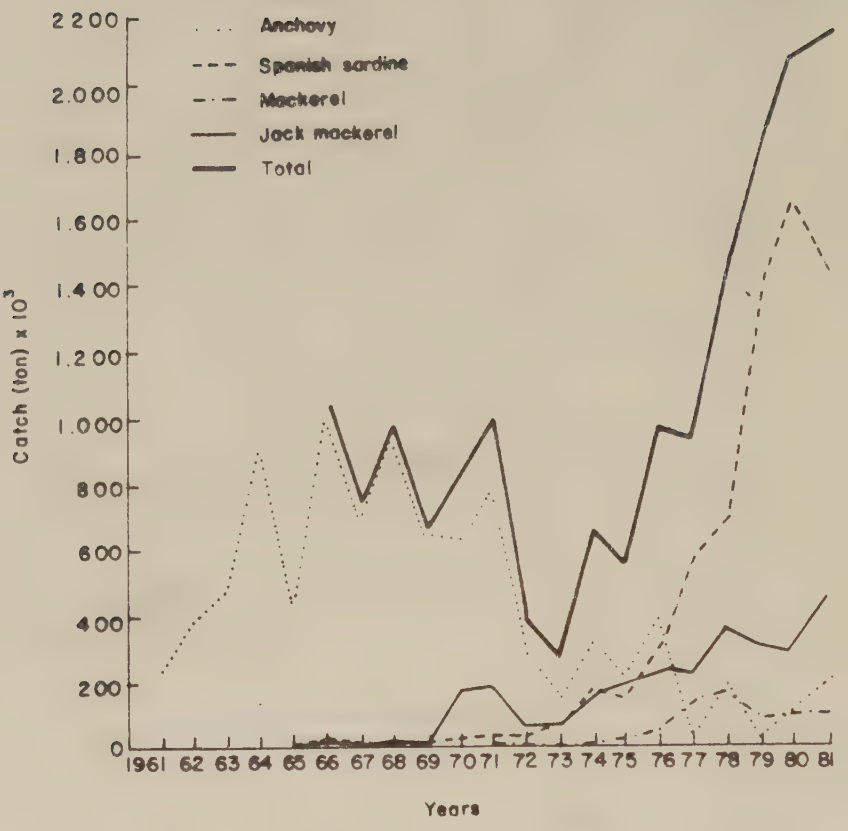


Figure 2

Total catch, by species, taken in the Chilean Northern Pelagic Fishery (1961-1981)

2.1 Catch

Figure 2 shows the quantities of anchovy, Spanish sardine, jurel and horse mackerel caught in the northern zone between 1961 and 1981. Changes in the abundance of the four species are clearly reflected by catches, the most important being the collapse of anchovy (1977) and the change, between 1973 and 1977, from practicaliy monospecific fisheries (possibly succession fisheries would be more correct) to multispecific fisheries, resulting from the great increase, mainly of Spanish sardine, jurel and horse mackerel.

In 1978, Spanish sardine became the dominant species in the system, amply surpassing the other three in 1979, with a record catch of 1,592,000 tons in 1980. In 1981 it decreased to 1,425,000 tons.

Jurel was second in importance in 1978, and after a slight decline in 1979-80 it increased substantially in 1981 totalling 435,000 tons.

At the beginning of 1977 anchovy showed a marked fluctuation of about 100,000 tons, typical of a collapsed resource.

Finally horse mackerel, witih a maximum catch of 170,000 tons in 1978, after sustained growth, showed a somewhat erratic behaviour.

It is important to point out the level of total catches in the northern zone in the years in which anchovy was dominant (1961-1971) and in the years when Spanish sardine was dominant. The level reached since 1979 with Spanish sardine as the main species is twice as great as that reached in the 60's with anchovy as the principal species.

2.2 Fleet and fishing effort

The fishing fleet of the northern zone is composed of purse seiners. This fleet had a maximum of 251 boats in 1965 and then declined until 1974, when it reached 100 units. It began to increase again in 1965 to 128 boats in 1980 (Figure 3).

The purse-seiner fleet of the northern zone is composed of three small fleets which correspond to the most important ports, i.e., Arica, Iquique and Antofagasta (includes Mejillones). The most important changes, as regards the number of boats, take place in Iquique, it being the evolution of this small fleet which mainly accounts for the changes in the fleet of the northern zone.

As a result of the incorporation of new boats in Iquique and Arica, the number of boats began to grow again in 1974 but much more moderately than in the 1962-1965 period.

The increase in size of the boats is expressed by the capacity of the average fish-hold. Figure 3B shows the evolution of the size of the boats in the fleets of Arica, Iquique and Antofagasta (including Mejillones). The increase in the average capacity of the fish-hold is the result of the incorporation of larger fishing units, withdrawal of the older and smaller units, transferred to other ports and also to other fisheries, such as Talcahuano for example (Serra, 1978). It may also be observed that most of the renewals in the fleet are made in Iquique, where the curve continues to increase after 1970; on the other hand, it becomes stabilized at the other ports.

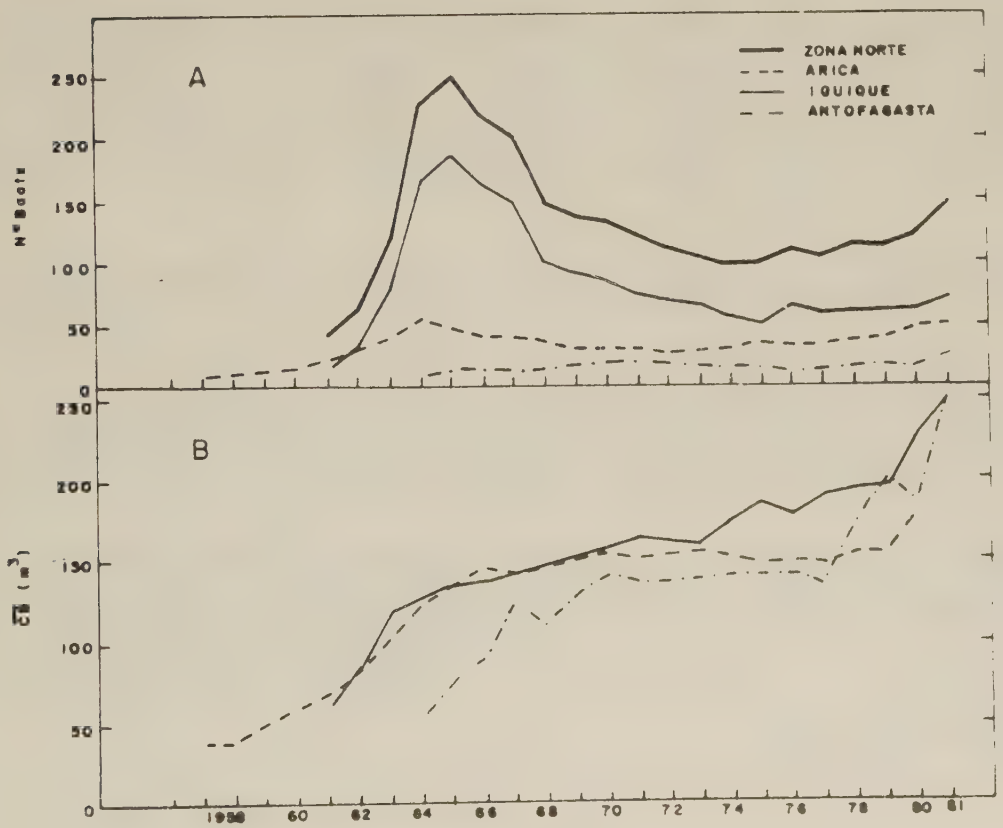


Figure 3

Evolution of the fleet of the Chilean Northern Pelagic Fishery (1958-1981)
A = number of boats, B = boat size, expressed as mean hold capacity

Table 2. Technological evolution of the fishing gears and systems

YEAR	$\overline{CB}$	ECOS. %	SONAR %	P.B. %	B.ABS. %	B.CAPS. %	RED 1/2" %	RED 1 1/2" %	SIST. PETREL* %	AVION %
1959	-	?	-	?			-			
1960	-	-	-	-			-			I
1961	66	100	-	67			100			-
1962	82	100	-	78			100			-
1963	114	100	-	-	I		100			-
1964	125	100	-	100	59		100			100
1965	133	100	-	100	97		100			100
1966	137	100	-	100	100		100			100
1967	141	100	-	100	100		100			100
1968	144	100	-	100	100		100			100
1969	148	100	-	100	100	?	100			100
1970	154	100	-	100	100	-	100			100
1971	157	100	6	100	100	-	100			100
1972	157	100	-	100	100	27	100			100
1973	160	100	-	100	100	-	100			100
1974	160	100	-	100	100	-	100			100
1975	163	100	-	100	100	-	100			100
1976	166	100	-	100	100	-	100			100
1977	169	100	13	100	100	100	100		I	100
1978	-	100	-	100	100	100	100	I	-	NS
1979	-	100	-	100	100	100	100	-	-	100
1980	-	100	-	100	100	100	100	100	-	100
1981	228	100	-	100	100	100	100	100	-	100

$\overline{CB}$: Average hold capacity
ECOS: Ecosonda
PB : Power block
B. ABS: Pump
B. CAPS: Capsule pump
RED 1/2": Net 1/2"
RED 1 1/2": Net 1 1/2"
SISTEMA PETREL: Petrel system
AVION: Airplain

? : Supposed year of introduction
- : Without data
I : Year of introduction
NS : Beginning of night survey
* : Mainly on 300 - 350 m^3 Hold capacity size fishing boats.

Serra (being printed) states that, together with the historical growth of the fleet, there is a gradual improvement in fishing gear, such as the incorporation of the power block, absorption pumps, acoustic equipment, nets, airplanes for prospecting activities and collaboration in fishing operations. Table 2 shows the years in which this equipment was incorporated and the percentage of the fleet affected. Subsequently, in 1978, other changes were made such as the replacement of the 13 mm mesh size anchovy net by a 38 mm mesh size sardine net. Night-time fishing was also generalized during this year with the incorporation of aerial surveys. Actually, night-time fishing in the northern zone was started in 1976, but without the use of airplanes.

Due to the difficulty of obtaining data regarding the time spent searching, fishing effort is measured by the number of trips, using two units: total of standard trips and trips with standard success. The total number of trips is obtained by adding the fishing and non-fishing trips. The criterion used to separate results by species is to assign the fishing trips to the dominant species in the landings.

Estimates of the fishing effort by species have been used to obtain indexes of catches per unit effort for the purpose of analysing changes in stocks (Serra, manuscript).

2.3 Stock abundance

To describe the changes in stocks in past and recent years, use has been made of catch per unit effort and of the catch itself as stock indexes. Catch has been used under the assumption that there is a good correlation between the latter and stocks, when the effort is big and there are no limitations to the volume of catch. Catch trends for different species have been commented on in a previous paragraph.

It is now recognized that catch per unit effort is not a good index to describe changes in stocks quantitatively (MacCall, 1976; Ulltant, 1976; Schaaf, 1975). Nevertheless, as may be seen in Figures 4 and 5, it presents a similar trend to the catches (Figure 2) for different species. This is confirmed in the case of Spanish sardine, for which data are provided by an analysis of the virtual population (Serra and Zuleta, 1982), in which an estimate was obtained of the stocks expressed by the average biomass, shown in Figure 6, where it may be seen that stocks of this species increased since 1974 in a similar pattern.

Catch and catch per unit effort are useful in describing the phase of explosive growth of these resources qualitatively. However, their use is considered to be quite limited to describe their stabilization and decline.

In 1981 and 1982 acoustic surveys were made in June-July and July-August respectively (Serra and Zuleta, op.cit.). These surveys covered the area from the border with Peru to 30- Lat.S. and up to 200 n.m. The estimated biomass of Spanish sardine in the area from the border with Peru as far as Antofagasta (24- Lat.S.) was 5,500,000 and 5,100,000 tons for each year respectively.

With the method for analysing virtual population, an estimate was obtained of the biomass of the average population for the years 1974 to 1981. Results show that in 1980 and 1981 stocks of Spanish sardine, from age three onwards, were at a level of 8,500,000 tons. The difference from the results obtained with the acoustic method is being analysed.

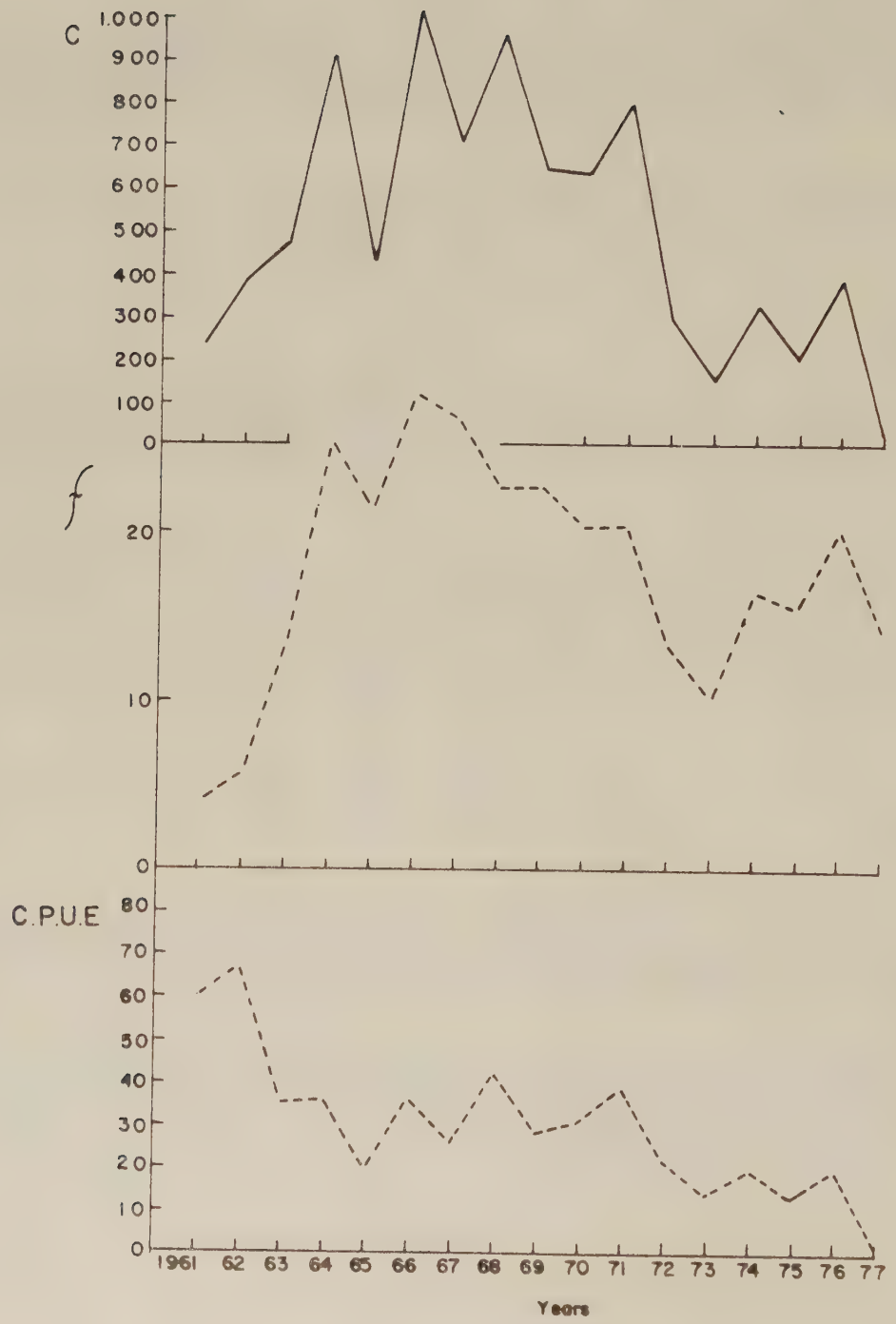


Figure 4

Catch, effort and CPUE of the Chilean Anchovy Fishery of the northern zone (1961-1977)

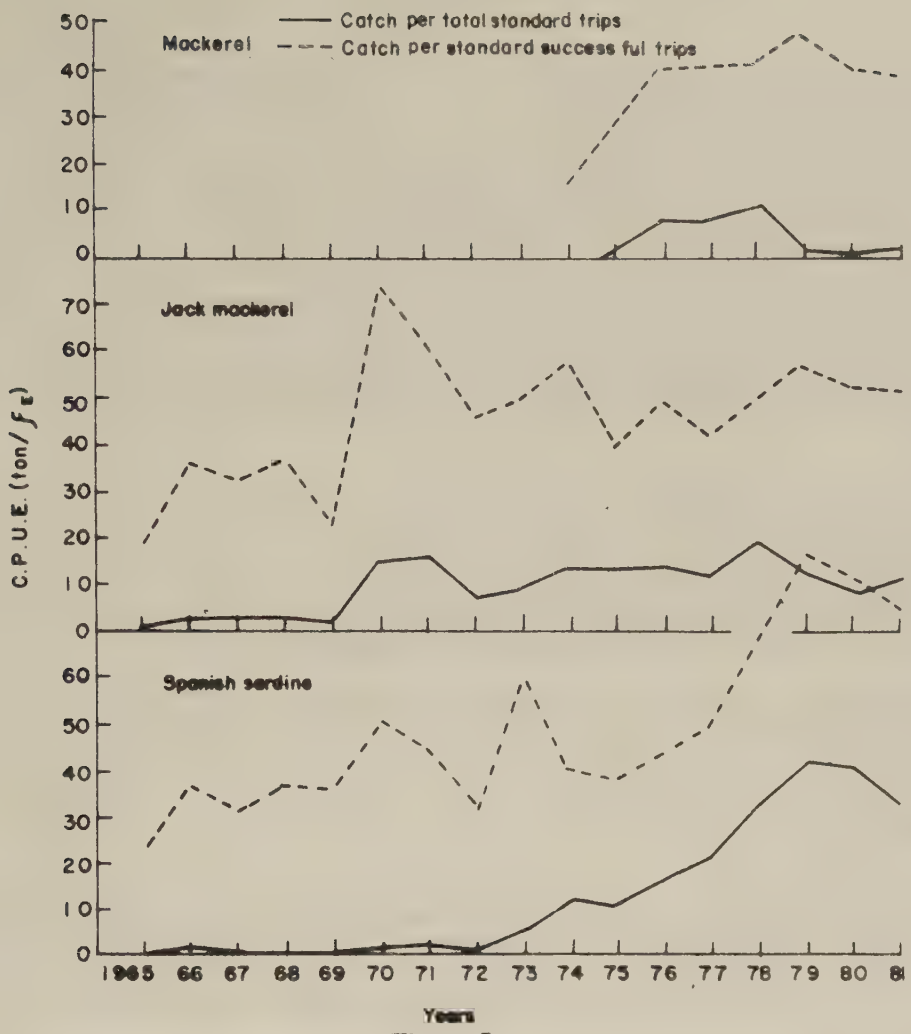

Mackerel
Catch per total standard trips
Catch per standard success ful trips
Jack mackerel
Spanish sardine
C.P.U.E. (ton/f_E)
Years
1965 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

Figure 5

CPUE of mackerel, jackmackerel and Spanish sardine
of the Chilean Pelagic Fishery of the northern zone (1965-1981)

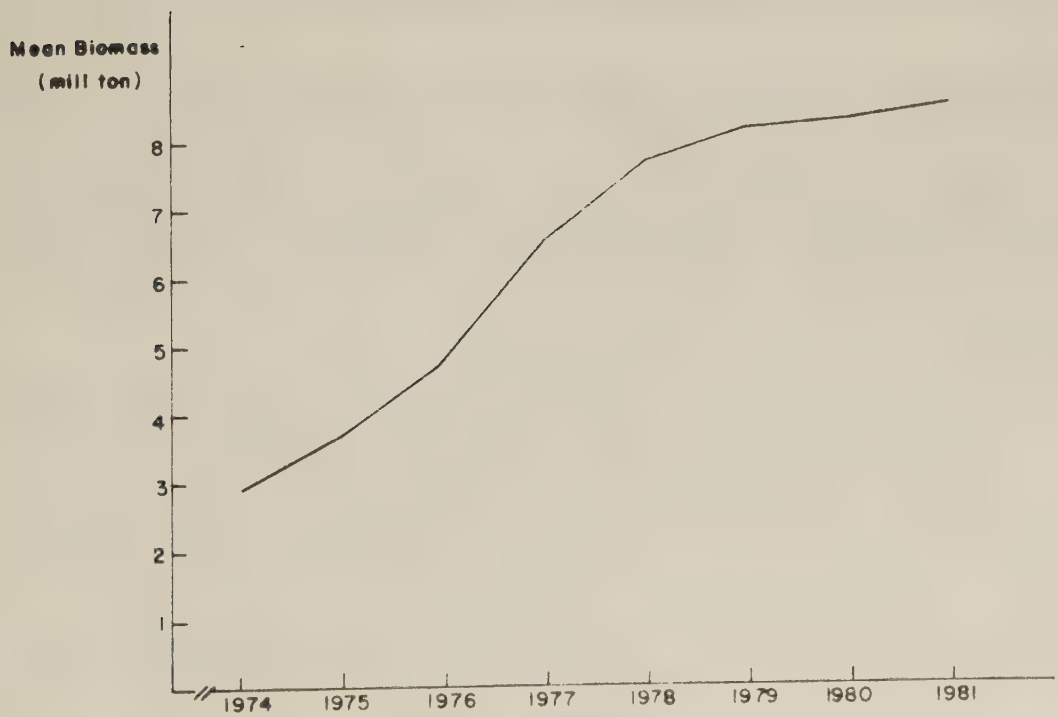


Figure 6

Change in the mean biomass of the Chilean Spanish sardine (1974-1981)
estimated by VPA (from age 3)

3. HISTORIC REVIEW OF MANAGEMENT

3.1 Promotion stage

During the 1957-1963 period, the Government aimed its efforts at promoting the development of the industry and fisheries research.

The development of the industry was favoured by government policy which stimulated investment through credit, tax exemptions and import privileges. This policy was established for the purpose of providing a labour alternative in the northern zone of the country to absorb unemployment originating in the crisis of the saltpetre industry in that area. The incentive to invest increased even more as a result of the great expectations arising from the spectacular development of the anchovy fishery in Peru.

On the other hand, research on pelagic resources was developed through two technical assistance projects, one with the government of Germany and the other with UNDP/FAO. The results of these projects were the Brandhorst Report (1963) and the establishment of the Fisheries Development Institute the same year. These initiatives which were of a general nature and were oriented towards the promotion of fisheries activities, led to research programmes which served as a basis for others and constituted the beginning of systematic research on these resources.

The characteristic of this stage is the accelerated development of fisheries based on an optimistic assumption about anchovy stocks, which would subsequently lead to considerable over-investment.

3.2 The anchovy crisis

Free access to fisheries led to an explosive development of fishing effort and capture, resulting in great pressure on the anchovy stocks and economic inefficiency, which caused a serious crisis in this activity in the years 1965 and 1972-1973. During 1965 the Government, through the Corporation for the Development of production (CORFO), took action after the situation arose to ameliorate the industrial crisis derived from over-investment and the unforeseen changes in resource stocks.

At the time, the Department of Fish and Game of the Ministry of Agriculture, which was responsible for the management of fisheries, tried to apply a regulation on volume of catch, which did not secceed because it did not have a sound enough technical basis and lacked the necessary elements for enforcement.

The 1972-1973 crisis took place under different circumstances. In the preceding years the Fisheries Development Institute carried out a research programme on pelagic resources, through which an important amount of information was gathered. However, no regulation was legally adopted, and the only thing to be mentioned in this respect is an agreement between the Ministries of Fisheries of Peru and Chile to establish a moratorium of one week for the capture of individuals of less than 11.5 cm in total length exceeding 20 percent of the landing in fisheries activities carried out in the area of Ilo (south of Peru) and Arica (northern Chile). The purpose of this measure was to protect the breeding stock which remained of a population unit shared by both countries. This agreement lasted until 1973, when a change took place in the political regime of Chile.

After this event and until 1978 the Fisheries Development Institute continued to carry out research and updated analysis of the state of pelagic fisheries, many of the latter having been carried out at the request of the Fisheries Protection Division, as the Department of Fish and Game was later called, but no measures were adopted except two military edicts, originated by the regional governments outside of the institutional framework of the fisheries administration. The first one (December 1973) established a moratorium of one month for Arica and Iquique and the second (December 1977) a closed season for the area along the coast to avoid conflicts between industrial and artisanal fishermen.

The concern of entrepreneurs about the collapse of the anchovy passed quickly, due to the fortunate substitution of species, as a result of which other species, mainly Spanish sardine, replaced anchovy reaching even higher and unexpected catch levels.

3.3 Structure of Fisheries Administration

A restructuring process of the public sector was completed in 1978, with the organization of the administrative function in two agencies: the Undersecretariat of Fisheries (SUBPES) and the National Fisheries Service (SERNAP), both of which depend on the Ministry of Economy; the first is of a normative and the second of an operative character, devoted mainly to controlling management norms and gathering statistical data. The management function is more clearly defined and is provided with the technical and legal elements and administrative authority required to make it more effective.

The immediate result of these changes in the management of pelagic fisheries was, on the one hand, the formulation of a national management programme for pelagic resources (SUBPES, 1980) with a better conceptualization of fisheries problems in every aspect and, on the other, a more determined action to manage it which was actualized in the regulations described below.

4. PROCEDURES FOR STOCK ESTIMATION AND DESIGN OF REGULATIONS

An analysis was made in 1981 of the situation of pelagic resources (SUBPES, 1981), especially of Spanish sardine, for which all available information was taken into account, i.e., patterns of landing curves in similar fisheries, catch per unit effort, exploitation rate, modal sizes, dependency model of catch/effort, which were integrated in order to make a diagnosis.

Two patterns in particular became evident through analysis based on the history of landings in pelagic fisheries of other countries (sardine and horse mackerel in California, sardine in Japan, and menhaden on the Atlantic coast of the United States), in addition to the country's own landings. The first beginning with a phase of rapid development up to a maximum followed by an abrupt decline, and the second starting also with an accelerated development phase but, after reaching a peak, passing through a "plateau" of great instability with severe fluctuations and ending by declining abruptly.

As regards Spanish sardine, in accordance with the landing curve (Figure 2) and the behaviour of the curve of catch per unit effort, in which would indicate combination of the growth phase of the stock, it may be expected that, under a regime of non-regulation or inadequate regulation, one of these two patterns will develop with the consequences which are already known.

An exploitation rate of 43 percent as estimated for Spanish sardine (SUBPES op.cit.), compared with the exploitation rate of 30 percent (which results when F=M), is excessive. This criterion to define the adequate level of exploitation emerged from the empirical evidence provided by the analysis of several similar fisheries in the world (Troadec, et al., 1980).

Furthermore, the decrease in modal sizes between 1978 and 1980, from 32.5 cm to 28 cm total length, can also be interpreted as the result of levels of exploitation which are too high.

Another element considered in diagnosing the state of the resource was the use of a dependency model of catch/effort. This model more adequately describes the dynamics of pelagic resources synthetically (Clark, 1974; Gulland, 1976) which, (Figure 7), when fisheries operate without regulation as in the case of the stock of Chilean anchovy, reaches a maximum level of yield very close to the critical point, when the population is susceptible to catastrophic changes in its dynamics.

All of the above indicated the existence of a situation of high risk, which made it advisable to reduce the rate of exploitation in order to increase the probability of resource permanence at satisfactory levels of abundance for the fisheries activity.

In line with this, the following regulatory measures acquired importance:

(1) Prohibition of the use of purse seiners along a strip of 1 km from the coast:

Knowledge of the spatial distribution of these species of economic importance, which sustain the pelagic fisheries of the northern zone, indicates that the coastal strip is a breeding area for the species. As the younger individuals of the immature fraction of the population are protected, the source of recruitment is protected.

(2) Determination of a minimum size for Spanish sardine and jurel:

The minimum size for Spanish sardine and jurel was estimated on the basis of the criterion of the critical age, thus aiming at a more efficient use of the growth of the species (over-fishing by growth) and at the same time obtaining the benefit of increasing the expectancy of an individual reaching sexual maturity.

(3) Determination of the quota or allowable capture of Spanish sardine in the northern zone for 1982:

The allowable catch was determined as follows:

(a) Projection of the catch of Spanish sardine for 1981, which was based on the data available up to September of that year and seasonal patterns observed during 1978, 1979 and 1980.

(b) Establishment of a catch rate of 39 percent instead of 43 percent as a gradual reduction aimed towards the desirable level of 30 percent.

(c) Calculation of the allowable catch using the catch equation of Baranov, assuming that the existing biomass in 1982 was the same as that in 1981. The estimated quota was 1,300,000 tonnes.

During 1982, with more complete information on the age structure for the 1974-1981 series, mortality estimates were verified. New estimates of stock size were obtained through the VPA and the acoustic evaluation method (Serra and Zuleta, op.cit.). In this respect, mention should be made of the application of the methods of successive age groups, catch curve and empirical physiological equation (Pauly, 1980).

All these data were used in an evaluation of the diagnosis, which was corroborated, and are being considered for the calculation of an eventual quota during 1983.

Furthermore, the VPA provides an optimistic prospect for the short term (two years) regarding stocks, because no decrease is manifest in the strength of the year classes which are entering the fishery.

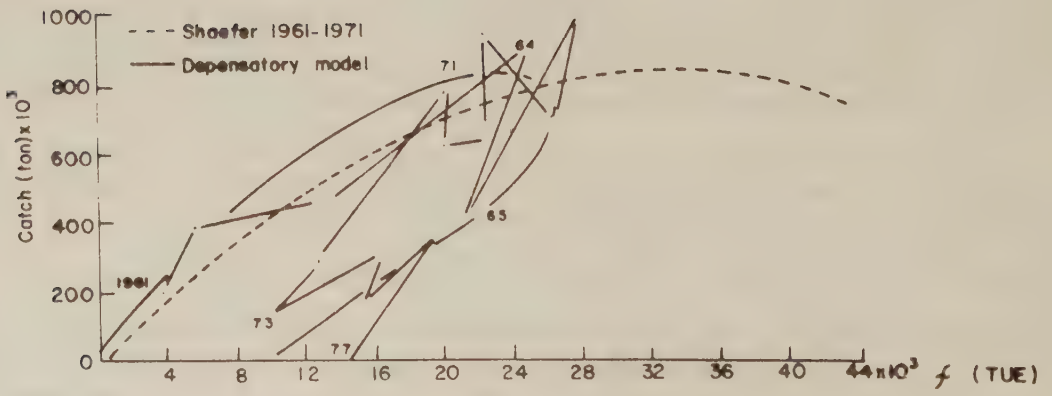


Figure 7

Catch-effort curve of anchovy in the Chilean northern zone
Effort is expressed in total standard trips (TVE)
Depensatory curve was fitted by hand

5. ADOPTION OF REGULATIONS

In 1981, the Undersecretariat of Fisheries, as a result of the evaluation of the state of pelagic resources, concluded that it was necessary to adopt management measures. For this purpose three regulations were promulgated with respect to:

(1) Restriction of size of Spanish sardine and jurel (Decree Law No.458)

(2) Restrictions to be applied to pelagic fisheries in the northern zone on the use of purse seiners in breeding areas (Decree Law No.459)

(3) Catch quota for Spanish sardine fisheries in the northern zone during the yearly season of 1982 (Decree Law No.460)

The first regulation fixes a minimum size of 20 cm total length for Spanish sardine and a 26 cm fork length for jurel. Nevertheless, a catch of smaller sizes than that established for both species, is allowed only as by-catch, at a rate not exceeding 20 percent, of the main species landed.

A second regulation forbids the use as fishing gear of nets of a depth exceeding 20 fathoms and a net with a mesh size equal or below 38 mm between knots, during a period from 1 November of each year to 31 May of the following year, in fisheries along a strip one mile wide from the coast between parallels of 18-28'00" latitude south and 25-00'00" latitude south.

The third rule establishes an allowable capture of 1,300,000 tonnes of Spanish sardine in the maritime zone under national jurisdiction, between parallels 18-28'00" and 25-00'00" of latitude south for the period 1 January to 31 December 1982. Regulations also establish that, after the quota has been completed, a catch of Spanish sardine is only permitted as a by-catch, in a quantity not exceeding 20 percent of the main species of the landing.

The quota was subsequently supplemented by 116,000 tons (Decree Law No.263), which represented the establishment of an exploitation rate of 42 percent.

6. ENFORCEMENT OF THE REGULATIONS

SERNAP controls the enforcement of the above regulations. For this purpose the agency, which is regionally structured, has several offices located along the coast in cities near to the main fishing ports (Arica, Iquique, Antofagasta). Enforcement is carried out from each of these regional bases in two steps.

First, in coordination with the Maritime Office, coastal surveillance is maintained from observation points on land and ocean patrols, to control the entrance of boats with forbidden gear into breeding areas. Landings are inspected in order to control minimum sizes in catches and regulations and control actions are disseminated among fishermen and the community. In this stage the monitoring of landings to control the allowable catch was carried out by SERNAP through its fishery statistics system with the support of information provided by the Fisheries Development Institute. Subsequently, in a second step, samples of the specific composition and volumes of landings were taken in addition to the above tasks, to control the quota and minimum sizes caught more accurately.

As a third step, it is necessary to improve enforcement activities substantially, which requires, on the one hand, that this function be provided with better means and, on the other, that greater emphasis be placed on preventive activities to support the purpose of the regulation.

7. RESULTS OF THE APPLICATION OF REGULATIONS

Among the rules applied, the most important is the evaluation of allowable catch. This measure gave rise to conflict because the quota was filled before the end of the term for which it was established. In view of this, fishing entrepreneurs started a series of negotiations with the authorities in connection with the socio-economic problem that originated when activities were stopped. This, which was aggravated by the serious recession in the national economy, presented authorities with the dilemma of having to favour the activity or apply the regulation. Finally, the first alternative was chosen.

The main argument used to support this decision was that the end of the season for catching Spanish sardine was near, according to its seasonality, and that therefore the application of a supplementary quota involved an acceptable marginal risk, considering that it was thus possible to solve the problem that had arisen. The supplementary quota was also completed before the end of the season, causing the same difficulty again. As a result, and based on the reasons already mentioned, finally no limitation was set for Spanish sardine catches.

The Under-secretariat of Fisheries, concerned about the difficulties of achieving the management purpose for this fishery, decided to set up a Consultative Technical Commission, composed of representatives of fishing enterprises, the Fisheries Development Institute, the National Fisheries Service and the Under-Secretariat itself.

Finally, the non-pessimistic short-term projection resulting from the second evaluation of this resource indicates that measures compatible with a wider variety of conditions, both economic and social as well as biological, still would be permissible. In this sense the quota by itself has not been a satisfactory regulatory mechaism and needs to be modified.

8. REFERENCES

Brandhorst, W., 1963 Der Stand der chilenischen Fischerei und die weiteren Aussichten fuer ihre Entwicklung. Valparaiso, Chile, Bundesauslandshilfe fuer Entwicklungslaender, 151 p.

Clark, C.V., 1974 Possible effects of schooling on the dynamics of exploited fish populations. J.Cons.CIEM, 36(1):7-14

Gulland, J.A., 1976 The stability of fish stocks. J.Cons.CIEM, 37(3):199-204

MacCall, A.D., 1976 Density dependence of catchability coefficient in the California Pacific, Sardinops sagax caerulea, purse seine fishery. Rep.Calif.Coop.Ocean.Fish.Invest., (18):136-48

Schaaf, W.E., 1975 Status of the Gulf and Atlantic menhaden fisheries and implications for resource management. Mar.Fish.Rev., 37(9):1-9

Serra, J.R., 1978 La pesqueria de sardina comun (Clupea (Strangomera) bentincki) y anchoveta (Engraulis ringens) de Talcahuano; analisis de su desarrollo y situacion actual. Invest.Pesq. Inst.Fom.Pesq., Santiago, (29):21 p.

————, Cambios de la abundancia de los recursos de sardina espanola (Sardinops sagax musica), jurel (Trachurus murphyi) y caballa (Scomber japonicus peruanus) del norte de Chile. (MS)

————, Desarrollo de la pesqueria de anchoveta (Engraulis ringens Jenyns) y los cambios de su abundancia (in press)

Serra, J.R. and A. Zuleta, 1982 Antecedentes biologico pesqueros de los recursos pelagicos de la pesqueria zona norte, con enfasis en la sardina espanola. Santiago, Chile, Subsecretaria de Pesca. Informe interno

SUBPES, 1980 Programa Nacional para la evaluacion y pronostico de recursos pelagicos, 1980-1984. Santiago, Chile, Subsecretaria de Pesca.

————, 1981 Fundamentos tecnicos de los Decretos Nos. 458, 459 y 460, del Ministerio de Economia, Fomento y Reconstruccion. Santiago, Chile, Subsecretario de Pesca.

Troadec, J.-P., W.G. Clark and J.A. Gulland, 1980 A review of some pelagic fisheries in other areas. Rapp.P.-V.Reun.CIEM, 177:252-77

Ultang, Ø., 1976 Catch per unit effort in the Norwegian purse seine fishery for Atlanto-Scandian (Norwegian spring spawning herring). FAO Fish.Tech.Pap., (155):91-101

M-40
ISBN 92-5-102257-7